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A NEW PROFESSION
A PROBLEM IN LEVELS

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

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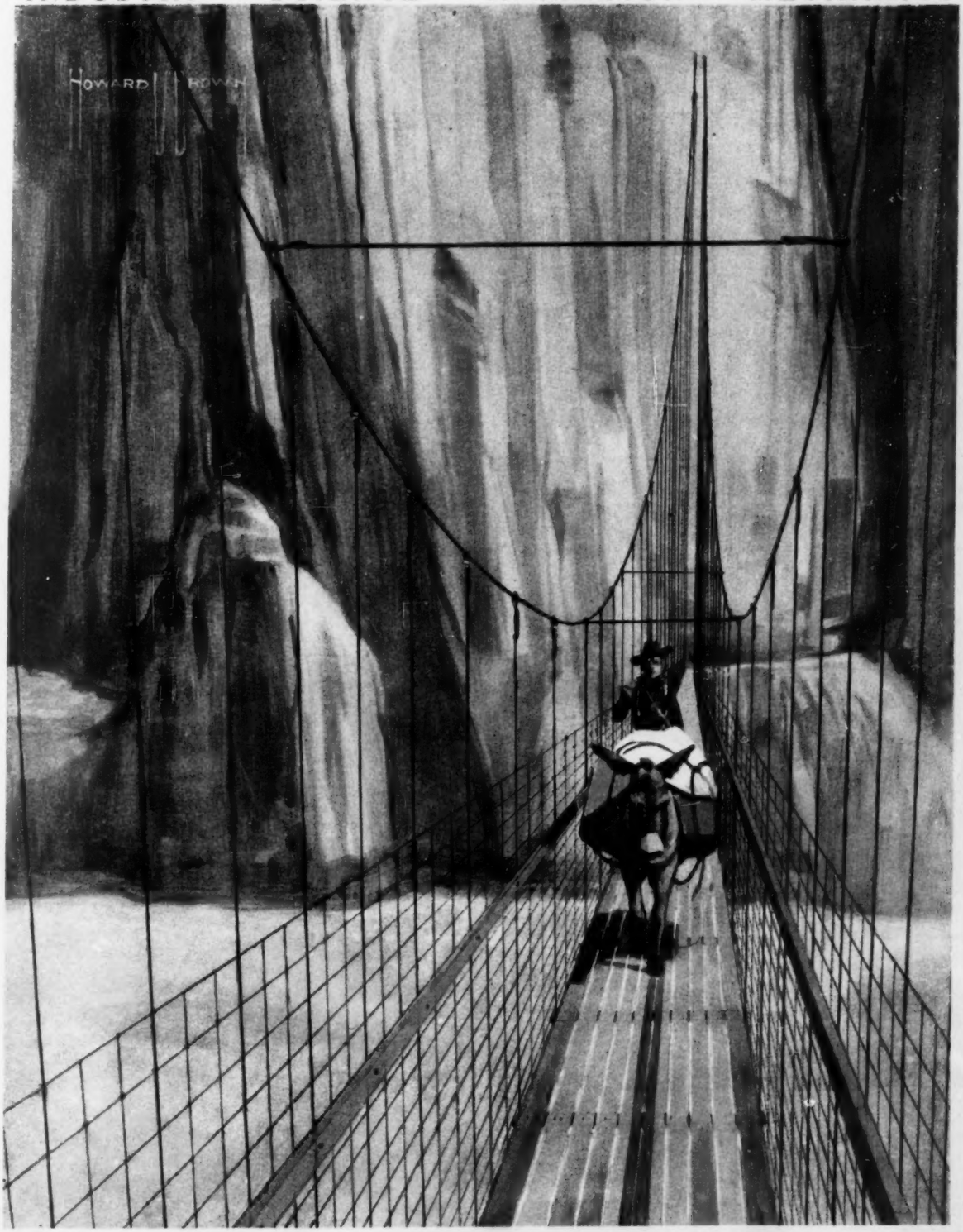

CROSSING THE GRANITE GORGE BRIDGE WHICH SPANS THE COLORADO RIVER.—[See page 203]

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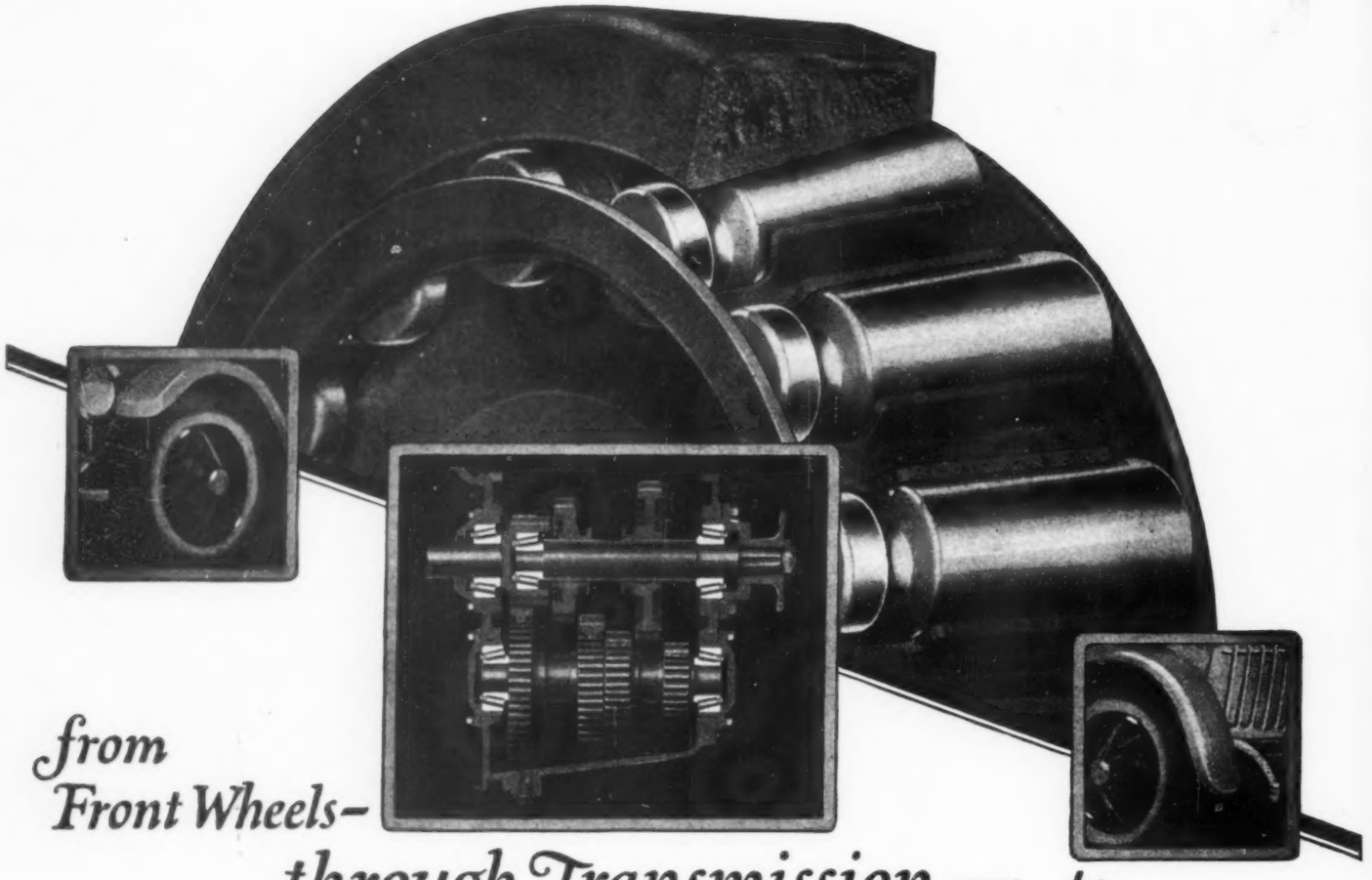

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SEVENTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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NEW YORK, SEPTEMBER 17, 1921

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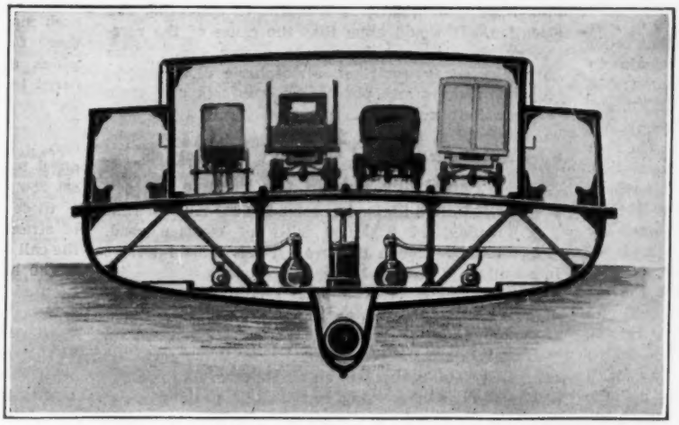
A New Type of Ferryboat

THE noteworthy expansion in the use of automobiles for touring purposes and of motor trucks for freight transportation has resulted in the development of a problem for ferry companies that has been difficult of solution by reason of the limited automobile carrying capacities of the prevailing types of vessels used for ferry purposes. To a certain degree this is the underlying basis for the high charges made by ferry concerns on automobiles and motor trucks seeking transportation across short bodies of water.

The Hullfin type of ferryboat, as here illustrated, affords over 100 per cent greater automobile accommodations than the usual ferryboat with a considerable increase in hull length. A survey of the largest marine steam ferryboat now building measuring 225 feet long and 66-foot beam over guards shows 410 feet of drive ways, whereas the Hullfin ferry, which is to be built for the Poughkeepsie and Highland Ferry Company, will be only 140 feet long and 52 foot beam over guards and will have a total length of 472 feet of drive ways. Its capacity, notwithstanding the smaller length of the boat, comes from its having four driveways, whereas the usual ferryboat has only two driveways. This is due to the fact that the propulsive equipment does not occupy any space on the main deck, being located as shown in the accompanying plans, in the hull and fin.

The new ferryboat will have all of its machinery below the main deck. The deck beams are unbroken throughout. The shoal broad hull with full ends, refined by the "Arconstruct" method, giving unusual ice crushing qualities, a method of construction that can be had only through the use of the Hullfin system without a corresponding greater increase in hull surface resistance, will afford greater stability and buoyancy, with no noticeable increase in draught when the vessel is heavily loaded. Vehicle transportation on present ferries necessitates even distribution of the load owing to the hull type, whereas on this type of ferry vehicles can be placed indiscriminately without dangerous careening or tilting.



Sectional view of the Hullfin type of ferryboat, showing the increased space for vehicular loads

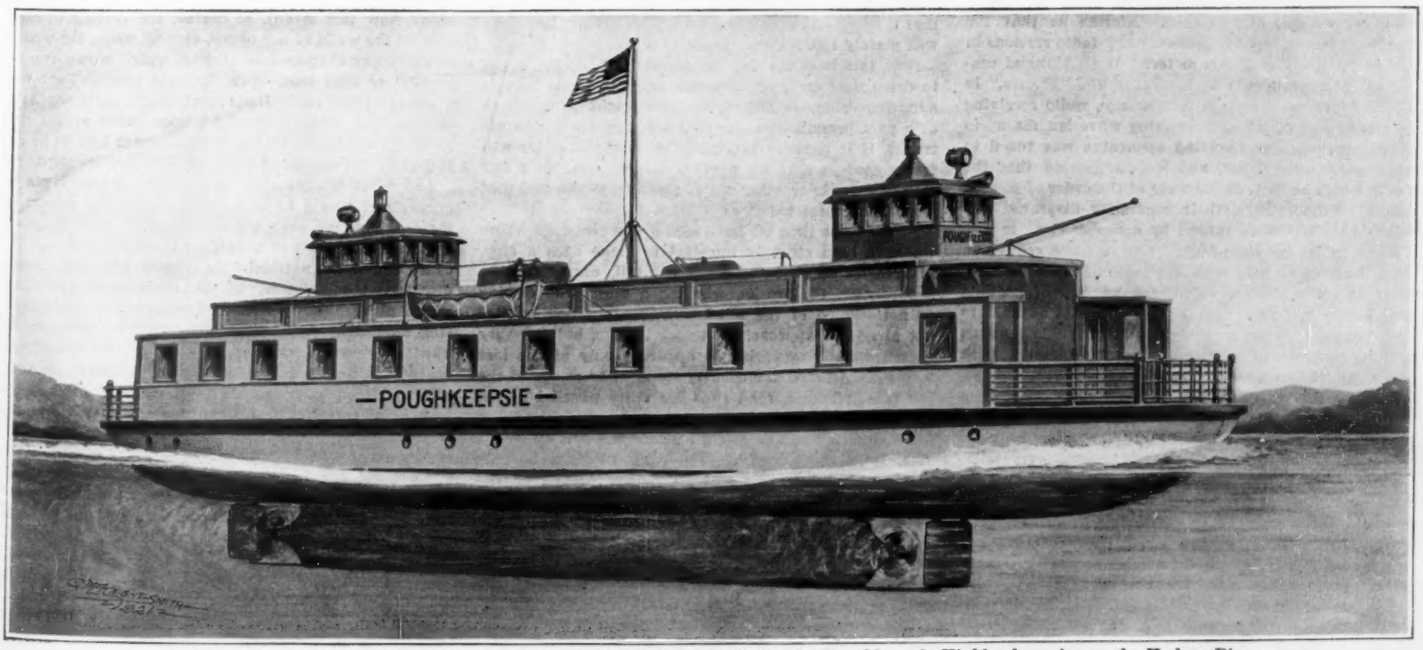
The electric motors are mounted directly on the propeller shafts, and cavitation being precluded small propeller wheels are used, effecting maximum propulsive force per shaft horsepower.

Water projected from the propellers cannot escape to the surface owing to the hull above, hence, the confined water column makes possible greater thrust, necessitating less power expenditure for a given speed and displacement than in ordinary practise. Another advantage claimed for this type is that it eliminates abrupt stern posts and rudders, and the confined space at the propellers, obviating vibration and attending depreciation of machinery, which, though usually attributed to engines, is actually due to the afore-mentioned causes.

The new ferryboat will be equipped with two six-cylinder Winton full Diesel engines, each direct connected to Westinghouse generators. There will also be a six-cylinder Winton generator set for lights, pumps, etc., and a Winton air compressor and exciters, chain driven from main engines. The pilot house will have electric control, and there will be arcola heaters, electric pumps, Westinghouse electric driving motors and complete subsidiary elements conforming to the most advanced engineering practises.

Rings Bell if Water is Found in Gas

A DEVICE which gives an alarm if the presence of a minute trace of water vapor is detected in a gas, has been recently developed by the Gas Chemistry Section of the National Bureau of Standards. The apparatus depends upon the electrical conductivity of a film made of a substance highly sensitive in revealing the moisture in the atmosphere. For example, phosphoric acid was employed, which as long as it is wet has a high conductivity but as it dries it is deprived of its conductivity. The new water indicator operates under the principle of keeping this at a constant temperature, and the device is made part of a circuit to ring a bell or operate some other signal.



The "Poughkeepsie"—a Hullfin type of ferryboat which is being built for the Poughkeepsie-Highland service on the Hudson River

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Those Martian Radio Signals

DESPITE its unique nature and its wealth of wonders, the radio art has its cycles, the same as many of the more commonplace fields of endeavor. Every so often we enter into a cycle of perfected radio, when we are told and assured that radio communication has been perfected and little remains to be achieved. Static interference from undesirable transmitters, and the several detrimental influences, such as sunlight, have been overcome, so we are informed. Then, but a short while later we learn that much remains to be done in the radio art, and that someone has been rather premature in his assertions.

And then there is the cycle of intense radio development, when radio telegraphs and radio telephones are to dot the world with thousands upon thousands of stations to the discomfiture, if not the doom, of telegraph, telephone, and cable. Still, the more conventional methods of communication seem to prevail, and the intensive radio development fails to materialize.

Again, there is the Martian radio signal cycle, which comes around every few years, more or less, with surprising regularity. The newspapers "play up" the announcement that mysterious signals have been intercepted, and give it all the significance and comment that goes with an opening-page story. The radio fraternity immediately splits into three camps—the believers in Martian signals, the out-and-out and irreconcilable non-believers, and the neutrals.

Just now we are in the Martian signal cycle again, after a lapse of something over two years. The facts in the case are that Mr. J. H. C. Macbeth, London manager of the Marconi Wireless Telegraph Company, Ltd., recently stated in his speech at a Rotary Club luncheon in New York, that William Marconi was now convinced that he had intercepted signals emanating from a source outside this earth. The signals which have been intercepted are reported to have an extremely long wave length; indeed, this fact alone now precludes the suggestion that they might originate in some experimental station in a remote corner of the world.

To be specific, Mr. Macbeth informs us that the maximum length of waves produced by radio stations in this world today is 17,000 meters. Until Marconi conducted his experiments on his yacht, the "Electra," in the Mediterranean several months ago, radio receiving apparatus was capable of receiving wave lengths up to 24,000 meters. His receiving apparatus was tuned to many times this figure, and it is estimated that the waves which he intercepted were of the order of 150,000 meters. Furthermore, their regularity disproved any belief that they were caused by atmospherics.

So much for the bare facts. Two or three years ago, when Martian signals were the topic of heated controversy in radio circles, we offered by way of possible explanation the fact that Soviet Russia was said to be hard at work on several long-range radio stations for the purpose of establishing communication with the world at large. Now that many newspaper correspondents, Red Cross workers, Government representatives and others have penetrated into the farthest corners of that famine-stricken country, we know only too well that the unfortunate Russians have plenty to do besides seeking new means of radio communication. Still, it is not altogether impossible that the signals emanate from some radio transmitter on this earth, either intentionally or otherwise. In radio transmission there is a phenomenon known as harmonics, in which a transmitter tuned for some definite wave emits supplementary waves of an altogether different wave length. Again, the extreme sensitiveness of the apparatus employed in present-day radio causes one to pick up the hums and the clicks of various commonplace circuits such as an ordinary electric elevator, electric street car, lighting circuit, bell circuit, telephone, and so on. In fact, the signals one picks up do not necessarily have to be radio signals.

But let us not assume for a moment that a man of the experience and knowledge of Marconi would confound such commonplace parasitic disturbances for radio signals. What Signor Marconi has heard must be signals that are distinctly out of the ordinary.

Somehow or other it is difficult to subscribe to the belief that radio signals are being received from Mars. Radio communication is such an intricate and exceptional development that it would be very rare indeed if two peoples, located on different planets, should have worked out precisely the same method of communication. We can more readily believe in the Martians making use of huge mirrors for reflecting light, or even huge searchlights, as a means of attracting our attention. It would seem that the cause of the mysterious signals must be sought nearer home. The harmonics of transmitters, atmospheric disturbances, magnetic storms and phenomena, sunspots and their peculiar influences—these possible causes are surely worth studying, not only for a solution of our present mystery but for the good of radio communication.

The Other Side of the Picture

THE United States has some 240,000 miles of railroads, and 2,500,000 miles of common road. Plainly enough the two systems must intersect in countless places; and comparatively few of these intersections can be other than at grade. With upward of 10,000,000 individual automobiles in operation, and with an annual train mileage little if any less than 10,000,000, nobody expects that grade-crossing accidents are going to be reduced to an absolute zero.

The onus of a crossing smash-up is ordinarily put upon the automobilist, and rightly so. He can stop in a fraction of the time and distance required by the train; and he can turn from his course. He is the party who is going to get damaged by any collision that may occur. He is therefore the party to whom we may reasonably look for precautions; and in many specific cases smashed gates and other evidence make it clear that he failed to take them.

At the same time there are two sides to this as to every story; the automobile has certain rights, even in the presence of a fast mail train. A number of our railroads recently collaborated in making and publishing a survey of the behavior of automobile drivers on approaching crossings. A deplorable proportion took no precautions to speak of. But the climax of the report was built out of the fact that only three drivers in a thousand "came to a full stop and looked both ways" before crossing. It was not explicitly stated that they all ought to have done this, but the inference was plainly left for the reader to make.

Now this is certainly unreasonable. That we ought to drive up to a grade crossing at a moderate pace is admitted—more definitely, that we ought to approach at a pace permitting us to stop before we get upon the tracks, if it becomes necessary to do so. But we will freely confess that we never yet have come to a full stop at a grade crossing out of mere suspicion, and that we never expect to.

At the same time we have seen grade crossings where we have been strongly impelled to make such a stop, in recognition that we could not tell, until we were squarely on the tracks, whether a train was coming or not. Some of the blind crossings are doubly so—not alone are approaching trains hidden, but the very presence of the crossing is apparent only at the last moment. All over the country we meet crossings of the jog type, where a road runs for miles parallel to the track, without warning to turn across at right angles. We know at least three such where the outside of the turn is at the top of a steep bank, so that the only alternative to hitting a train might be taking the plunge. For the reckless driver we hold no brief, nor do we deny his existence in vast number; but we do insist that no road ought to present trick crossings of such character that the conservative driver must be familiar with the road in order to be safe.

Of course the dangerous crossing is usually marked. But too little effort is made to discriminate between the crossings that are really dangerous and those that are not. In many states death's-heads and huge placards "MAN KILLED HERE" are posted at every crossing that has seen a fatality. We have seen such signs at crossings that were as wide open as it was possible for them to be—at the bottom of a hill, with a mile or more of the track in plain view of motorists approaching in either direction. The only effect of such indiscriminate placing of signs is to weaken the motorist's attention to them.

Cathedral Catastrophes in the Middle Ages

AS we sit at our desk with over 600 feet of the Woolworth Building held in mid-air above us, our thoughts run back to the cathedral builders of Mediaeval days and the not infrequent catastrophes which befell those soaring structures of fretted stone and painted glass which are today the delight and admiration of every artistic soul. To raise a Woolworth Tower some 800 feet into the air, and do it with such materials and in such fashion that it will stay there forever, is a simple task compared with that which confronted the Mediaeval architect when he dared to erect on four tall and relatively slender piers the towers and spires of a cathedral such as that of Salisbury, with its total height of over 400 feet, or even a square tower such as the famous and beautiful angel tower at Canterbury, which reached only a modest 230 feet above the ground level. For the builders of those days knew but little about the abstract theory of stresses, and they had no such formulæ as are at the call of any college student today.

The bishop of those days was more often than not the architect of his own cathedral; and there is much evidence in the cathedrals as they stand today that his work, at least in the earlier stages of the development of the Gothic art, was experimental. He built a massive, vaulted roof upon relatively slender piers and made a guess at the necessary diameter of piers, thickness of walls and so forth to hold his vault in place. If there were just enough material used and it were of fairly good quality, the work stood. If there were two or three times as much material as was necessary (and this, we have evidence, not infrequently happened) the work stood and all was well; but if their piers were too small in diameter, their walls too thin, or the rubble work constituting the core of the masonry was too poor in quality, down came the whole structure and the good bishop set about rebuilding, profiting by the costly lesson he had learned.

A most frequent cause of trouble was the great tower which was so much favored at the intersection of nave and transept. If there was to be an uninterrupted view throughout the full length of nave and choir, or from transept wall to transept wall, it became necessary to place great arches as tall as the roofs of the cathedral themselves at the intersection of nave and transept. Now this meant, of course, the cutting of huge gaps in the walls of the tower, concentrating the weight of the upper stages of the tower, which would run up to 4000 or 5000 tons, upon the four piers. That was a serious problem in itself; but worse than that, the effect of the huge tower load upon these arches was to produce a heavy lateral thrust, which had to be absorbed by the adjoining walls of nave and transept.

And what trouble they had! Piers would begin to buckle and would be hastily reinforced by adding to their thickness; arches would spread, causing great rents at the crown or thrusting the adjoining pier arcades out of the vertical. To remedy this and prevent disaster, the builders, as at Gloucester Cathedral, would carry buttresses right down the side walls, cutting diagonally across the aisle and transept windows until they could transfer the load to some outlying buttress or suitable mass of masonry. To the engineer and architect, by no means the least attraction of the wonderful cathedrals of France and England are the failures with which they were threatened and the clever expedients by which the emergencies were met.

Steel for construction was unknown in those days and iron was very, very scarce. Had they possessed these materials and our twentieth century knowledge of engineering, what stupendous buildings those priestly architects would have produced, particularly in northern France, where at Amiens, the crown of the vault is over 140 feet above the floor of the cathedral and at Beauvais, where in the effort to outdo Saint Peter's, Rome, the French carried their roof to an interior height of 156 feet—and all of this, mark you, in stone.

Automobile

New York's Stolen Car Industry. — It is reported that there were 7005 automobiles valued at approximately $7,000,000 stolen in the cities of New York State during 1920, according to figures compiled by the information bureau of the State Conference of Mayors. Of this number 3996 machines were recovered by the police.

A Danish Motor Vehicle Census was held on Sept. 1, 1920, and showed that on that date there were in the country 11,594 private passenger cars, 2273 motor cabs and omnibuses, 3787 motor trucks and 12,182 motorcycles. The rapid increase in the number of cars and trucks in Denmark during the past three years is noteworthy. The increase was specially great in the country districts.

Loose Nuts and Trouble.—The vibration on an automobile is so severe that nuts will loosen occasionally in spite of all precautions. A loose nut may cause the breakage of an important part or may even be the cause of the wrecking of the car. It is a worth-while safety measure to go over the nuts on the car about once a month. Ordinarily the work will not take more than five minutes' time.

Solders for Aluminum.—All tests on recent aluminum solders have been completed by the Bureau of Standards and Circular 78, "Solders for Aluminum" will now be revised to include these tests. In spite of claims made by those interested no solder for aluminum has yet been found which will withstand the corrosion test, although the fused zinc chloride solders resist it for the greatest length of time.

The Rocker Arms on overhead valve engines should be oiled religiously, unless provision is made for oiling them automatically from the engine, which is rarely the case. Usually the oil-can method is employed for lubricating these parts, and it is good practice to oil them every morning before taking the car out of the garage. It is work that only takes a moment and it prevents undue wear, which in turn insures a quiet and well-running engine.

An Oil Gun designed for use in a chassis lubricating system consists of a nickel plated metal bottle in which are located a piston and a heavy coil spring. The oil is contained in the upper part of the bottle and is put under pressure by the piston and coil spring. A length of flexible tubing is attached to the top of the bottle and the end of the tubing is equipped with a check valve which is released by the special fittings which replace the grease cups and oil cups on the car.

Gasoline Mixed With Alcohol or with benzol is now exempt from the French State tax of 20 centimes per liter. The decree declares that the mixture can be either 50 per cent alcohol and 50 per cent gasoline, or a mixture in equal proportions of gasoline, alcohol and benzol. Benzol and alcohol are readily mixed. Alcohol-benzol mixtures will not freeze at low atmospheric temperatures, but unmixed commercial benzol freezes at about 23 degrees Fahrenheit. The lightest grades of gasoline mixes with alcohol, but with heavier grades, and with kerosene separation occurs. Separation is prevented by addition of a mutually blending solvent such as benzol.

The Heat of the Engine which generally comes through the slots in the footboard of the average automobile is something which might well be remedied. In fact, it seems that a double wall, with a live air space between, could be placed between the engine and the front seat of the usual automobile, thus providing some protection against the excessive heat during summer driving. Furthermore, the usual pedal controls could be provided with some form of shields which would serve to stop the openings in the slots yet not interfere with the operation of the pedals. This phase of the automobile has undoubtedly been left in its original state, yet it offers a good field for the efforts of the ingenious mechanic.

The Friction Drive is again receiving attention after a long period of more or less total abandonment. At least one new make of car has lately made its appearance on the American market, in which an improved form of friction drive is employed with what are claimed to be important advantages over the usual gear drive. It will be interesting to note how this car thrives in everyday use. One thing is certain, the friction drive is excellent for small, light cars. One car making use of that form of drive made an enviable record for itself while it was being manufactured. Cars of that same make are still in existence, and their performance and low upkeep costs are truly remarkable. However, with the demand for larger and heavier cars the car in question gave way to other makes which had more to offer in the way of appearance and comfort at the same or less cost.

Science

Pike's Peak Aerial Patrol. — A Colorado aircraft company has agreed to keep a sharp lookout, without expense to the Forest Service, for fires in this district, which is remote from any army air field.

A Large Candle.—Here in New York is being made the king of all candles. It will be five feet in circumference and eighteen feet in height, and will weigh more than 1000 pounds. It is being paid for by the orphans of a home to which Caruso contributed $10,000 a year, and is destined for a church in Naples. The maker estimates that it will burn for 120,000 hours.

Progress of the Metric System. — Metric weights, now obligatory on Chinese railways, are said to have given rise to no trouble or complaint. The metric system went into force in Malta on July 1st. A chart issued by the Decimal Association shows consistent gains for the system during the past hundred years, with a particularly sharp rise to popularity in the last ten years.

Protein Tests.—Boston hospitals have been conducting experiments in protein sensitization by inoculating patients with proteins from foods and other substances. The reactions or absence of reactions are studied with particular regard to asthma and hay fever, but are being extended to indigestion, children's ailments and other diseases. The protein is applied in a weak solution of sodium hydrate to a tiny scratch on the skin.

Spitzbergen's Resources. — Spitzbergen, that long-ignored archipelago of the frozen north, is revealing its value. Its coal resources are estimated at 9,000,000,000 tons; it has much low-grade iron ore, deposits of copper, zinc, molybdenum, asbestos, gypsum and oil shale, and possibilities of free oil. Good harbors, frequent communication with Norway, and a climate comparable with that of Sweden, augur a prosperous future for the islands.

Chemical Industries Exposition.—The Seventh National Exposition was held in New York the week of September 12. The spacious drill floor of the Eighth Coast Artillery Armory accommodated 400 exhibits. In its auditorium were held symposiums and motion picture demonstrations. Chemical engineers from all States and abroad were here for the joint meeting of the Society of Chemical Industry and the American Chemical Society.

Osmiridium in Tasmania. — Recent exploration and development have revealed enormous deposits of osmiridium and gold-bearing gravels in the valleys of the large rivers of the western division of Tasmania, which is the sole producer on a large scale of "point metal" osmiridium. Tasmania, Russia, Colombia and Papua are the four principal osmiridium producing countries of the world, and Tasmania is by far the most important of these.

Science and Shoes. — Speeding up tanning without sacrificing leather quality is a question to be thoroughly discussed at the coming meeting of the American Chemical Society at Columbia University. Quicker tanning means time saved, more frequent turnover of capital, and leather—and shoes, which is what most men think of when leather is mentioned—at lower prices. Noted European leather chemists will attend this meeting, where novel tanning methods based on the study of electrical discharges will be described.

The Magellanic Gold Medal. — This medal will be awarded in December to the author of the best unpublished discovery, invention or improvement relating to astronomy, navigation, or natural philosophy (mere natural history alone excepted). The contest is open to all, but the discovery must be delivered free of charge to the President of the American Philosophical Society, 104 South Fifth Street, Philadelphia, on or before November 1st. It may be in English, French, German or Latin, and must be distinguished by a device or nom-de-plume and accompanied by a sealed envelope bearing the same device and containing the true name and address.

A Good Short Story.—The following is a museum label and is one of the best short stories ever written. For brevity and for conveying accurate information, it is worthy of perpetuation. "Far back in the past, during that period in the worlds' history known as the Triassic, the State of Connecticut was largely covered by the sea, and a bay, or estuary, extended as far north as Turner's Falls, Mass. One day, when the tide was out, one of the great reptiles, known as Dinosaurs, walked along the beach, leaving his footprints in the sand. The tide came in, the tracks filled with sand and mud; in the ages that followed this became stone, and a few million years later, in quarrying stone for New York houses, this track was uncovered."

Astronomy

Astronomical Postcards.—A second edition of Prof. Max Wolf's astronomical picture postcards has been published by the Pallas-Verlag, in Jena. The set comprises ten cards in an envelope, and sells for 7 marks.

Photographs of Mars.—It is stated that upwards of 100,000 photographs of Mars have been taken at the Lowell Observatory, Flagstaff, Ariz. Numerous exposures are made on each plate in the hope that some will catch the moments of best definition.

The Astronomische Gesellschaft, after having held no meetings for eight years, assembled in Potsdam in August of the present year. The former president of the society, Geheimrat von Seeliger, has resigned, on account of poor health, and has been succeeded by Professor Strömgren, of Copenhagen.

Nova Aquilae No. 3.—Dr. R. G. Aitken reports that this object was examined with the 36-inch telescope of the Lick Observatory on three nights in June and July. On June 4 it was noted that the blue-green nebulous envelope or halo which was so conspicuous in 1920 had become very much fainter and apparently larger, but the seeing on this occasion and on June 8 was not good enough to permit accurate measures. On July 7 seeing was excellent, and the nebulous envelope, though faint, was well defined. The diameters, north-south and east-west, were measured and found to be 5.07 and 4.98 seconds, respectively. The disk appeared to be perfectly round and the star to be placed centrally within it.

The Size of a Dark Nebula in Taurus is discussed by Dr. A. Pannekoek in the *Proceedings* of the Amsterdam Academy of Science. From data of star-density in this region, he estimates the dark nebulous matter to be 140 parsecs distant from our system, or four times the estimated distance of the Hyades. On this basis the length of the nebula is 70 parsecs. Its mass, assuming it to consist of hydrogen, is estimated at twenty thousand million times that of the sun. This, as Dr. A. C. D. Crommelin points out, is greater than many estimates of the combined mass of the whole sidereal system, and suggests the probability that the larger portion of that mass is not condensed into stars but distributed in cosmic clouds.

A New Hypothesis of the Aurora. — Most recent students of the aurora, such as Störmer, Birkeland, etc., ascribe the phenomenon to the entrance into the atmosphere of charged particles from the sun. Dr. L. A. Bauer, in a current paper, quotes a suggestion that he has received from Prof. A. E. Kennelly to the effect that the electrified particles entering our atmosphere from without over the parts of the globe on which the sun is shining would set up a compensating outward flow of electricity over other portions, and that it is the latter rather than the former that causes the visible aurora. Dr. Bauer's opinion is that "probably both possibilities—an entering charge and an emerging charge—will have to be taken into consideration."

A Novel Type of Observatory.—The 18-inch reflecting telescope recently presented by Mr. G. R. Hoskins to the people of Sydney, Australia, is housed in a building which differs considerably from the ordinary type of observatory. The floor surrounding the concrete block upon which the telescope is fixed is the only stable part of the building, the sides and roof of which revolve. One enters the building through the door which may at the time be facing south, but when one leaves it may be on the opposite side. The shutter in the roof is also a novelty, not folding or sliding sideways, as usual, but running upward in a frame. The observatory is under the supervision of the New South Wales Branch of the British Astronomical Association.

Effects of the Earth on the Sun.—That many terrestrial phenomena are more or less directly controlled by the sun is a matter of common knowledge, but the idea that our small planet exercises appreciable effects upon the sun is comparatively novel. According to Dr. L. A. Bauer, a discussion of the sunspot numbers for the period of 44 years, 1877-1920, indicates the existence of an annual periodicity in sunspottedness, consisting mainly of a single wave, the minimum occurring about the time (January) when the earth is nearest to the sun, and the maximum occurring on the average in July, when the earth is farthest away from the sun. The average difference between maximum and minimum is about 6 sunspot numbers. "There is thus," says Dr. Bauer, "given, seemingly, support to the results of others with regard to a possible earth-effect on various solar phenomena." Evershed, from spectroscopic observations on Venus, has inferred that the earth exerts a repulsive effect on the solar gases analogous to that which the sun appears to exert on comets' tails.

Left: The register at Wenatchee Forest, Wash., which enables the camper to be reached from the outside world. *Right:* Campers in the White Mountain National Forest, N. H.

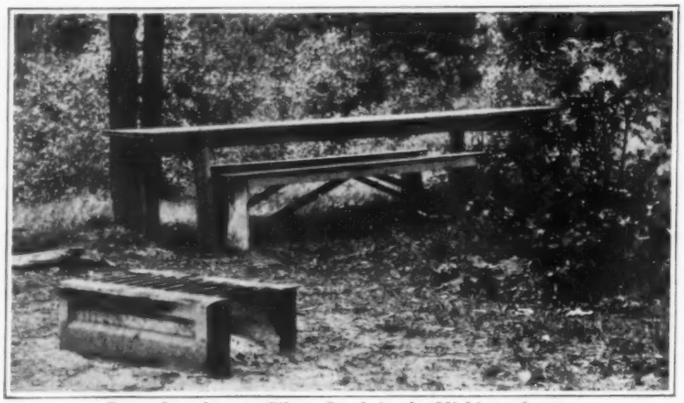
In the National Forests where the recreation engineer has been at work

A New Profession

The Recreation Engineer and His Part in Making Our Vacations Worth While

By Avis Gordon Vestal

THAT "all work and no play" may not "make Jack a dull boy," there has recently opened up a new profession: recreation engineering, called by others landscape engineering, recreation landscape design, or forest recreation. Scattered examples of such work have been done in past years, as a side issue, by persons whose main business was forestry or engineering or administration of public lands, but the recognition of play-preparation as a distinct profession, requiring technical instruction, is new. As yet, colleges offering such courses are few; their graduates not numerous. Those actively engaged in its teaching or practice are enthusiastic pioneers who believe that the time is ripe for a great expansion of informal out-door living and recreation for city-weary folk, adults and children, who are flocking to the big open spaces in family groups or as large organizations.



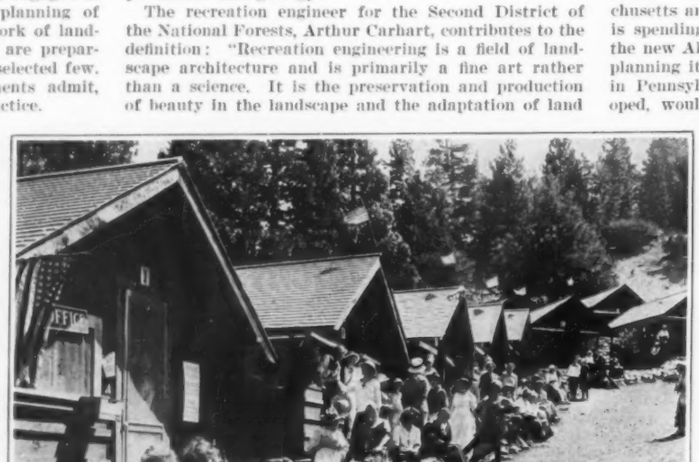
Camp-fire place at Silver Creek in the Michigan forests

What the profession does not include may help to its understanding. It isn't playground management, which supervises people while engaged in play; nor yet the familiar and formal planning of city parks. It is distinct also from the work of landscape gardeners and architects when they are preparing private estates for the enjoyment of a selected few. It is not even engineering, as its exponents admit, though it overlaps it in preparation and practice.

Iowa State College of Agriculture and Mechanic Arts, at Ames, has for two years offered a splendid forward-looking course. Frank H. Cully, the professor in charge, offers the following definition of the work:

"Recreation landscape design is a specialized adaptation of professional landscape architecture. It applies all the fundamentals of this art to areas which are being used for specialized recreation. As a rule, the landscape architect who is interested in recreation landscape design is designing on a much larger scale and for a larger group of people than the one who is doing city planning or estate work. No recreation landscape designer could be a success without being a thoroughly and technically trained landscape architect. With this in mind we have built up at this institution a course which will allow our students to specialize in this particular phase of the professional practice. The student is required to take our landscape architecture course and in his senior year he specializes in recreation landscape design. We are offering two courses in this subject, supported by elective subjects in the Forestry Department, such as 'Municipal Forests,' 'Forest Administration and Protection,' and 'Forest Management.' The student also gets considerable surveying, roads, pavements and geology."

The recreation engineer for the Second District of the National Forests, Arthur Carhart, contributes to the definition: "Recreation engineering is a field of landscape architecture and is primarily a fine art rather than a science. It is the preservation and production of beauty in the landscape and the adaptation of land surfaces to human use. It takes what is needed from the fields of engineering, geology, chemistry, horticulture, psychology and sociology. It deals with broad, public natural areas, such as national and state parks and forests, county forest preserves, such as those of Cook County, Illinois, or municipal forests. The problems are different from those in city parks. Details fitting admirably a Lincoln Park would be as out of place in the Superior National Forest as a striped jersey at a ministerial reception!"



Cottages at the Los Angeles municipal camp in the San Bernardino Mountains, 75 miles from the city

The New York State College of Forestry, at Syracuse University, has for two or three years offered instruction in the new profession under the name of "Forest Recreation." Prof. Henry P. Francis stresses forestry as the background of the course, rather than the art of landscape architecture, yet the object he seeks to serve appears to be the same as that for which Professor Cully trains his students. Professor Francis has for some years himself carried on landscape extension work in Massachusetts and New York. With one of his graduates he is spending this summer vacation doing field work in the new Allegheny State Park in southwest New York, planning its recreational development. It adjoins land in Pennsylvania, which, should it be similarly developed, would make a most attractive interstate park.

"Forest Recreation," Professor Francis states, "embraces the many and diverse uses of forest areas for the enjoyment of leisure by all the people. In its broadest meaning it includes all manner of provision for and ways of using leisure in connection with the National Parks, National Forests, State and Interstate Parks, County and Municipal Preserves, and all other public forest areas. The work will depend upon foresters with proper training in recreation uses of forest areas to bring about the greatest public good." Professor Francis offers to undergraduates four courses of 3 hours per week throughout a year, "Elements of Forest Recreation," "Principles of Forest Recreation," "Recreational Problems," and "National Recreation Policies in Forests and Parks." A 4-hour research study is arranged for graduate students.

The Massachusetts Agricultural College, at Amherst, is credited by Professor Cully as having first interested the United States Forest Service in this phase of the use of the National Forests. Prof. Frank A. Waugh, to whom the personal responsibility for this attaches, writes: "We do not give any courses in forest recreation as such, but the problems in

(*Continued on page 207*)

Philadelphia's Tear Bombs and Mobs

By William A. McGarry

A DEMONSTRATION that might have been billed as the re-enactment of a brisk raid through no man's land on the western front was held recently under police supervision on the meadows of South Philadelphia, serving to introduce the bluecoats of the Quaker City to a new offensive weapon against bandits and mobs—a weapon developed out of the poison gas warfare that was so bitterly denounced when it was first introduced. By actual tests against fifty stalwart members of the police "rookie squad" who courageously volunteered for the test, it was shown that tear gas bombs of a type recently invented are quite as effective as rifle or revolver fire, and far less deadly.

Two types of these bombs are now or shortly will be on the market for use not only by the police, but also by banks, storekeepers and paymasters. One contains the familiar lachrymose gas, the other what is known as "stunic" gas. As its name indicates, the latter stuns one who inhales it, leaving him virtually unconscious and utterly helpless for some minutes. The chemical constituents of the mixtures used in the bombs for the Philadelphia demonstration are withheld by the inventor. Experts of the chemical warfare section, however, are authority for the statement that this service has worked out several formulas for both types of bombs, all of which may be used without permanent injury.

This feature of the new gases and particularly of the lachrymose gas led Superintendent William B. Mills of the Philadelphia police to determine, after the demonstration, to establish five gas bomb squads. It is what makes highly probable the adoption of the bombs by banking institutions. Few persons care about the bandit or the bank burglar and it is a matter of little concern whether or not he is permanently injured. But gas clouds are no respecters of persons and under many conditions where their use might be advisable to stop crime innocent bystanders also would be caught.

According to a physician who handled thousands of cases of all kinds of gas poisoning on the Western front in France and who is now in charge of convalescents at the United States Public Health Service Hospital in Philadelphia, the effect of the tear bombs shown to the police in that city is identical with that caused by the lachrymose gas used by the Germans during the last few months of the war, although the chemical formula may be different. The gas causes irritation of the conjunctiva, the mucous membrane of the lining of the eyelids and of the anterior part of the eye itself. This disturbance is so intense and painful that it is impossible for the victim to keep his eyes open, and he is rendered helpless for from five to twenty minutes, depending on the concentration of the vapor when it makes contact with his eyes. In no case is there any permanent ill effect.

Knowing that the results would be exceedingly painful, the rookie squad nevertheless volunteered to be the victims of the demonstration. It was given on the "model farm" which Philadelphia operates on the meadows near the League Island Navy Yard. Major Stephen J. De Lanoy, formerly connected with the Chemical Warfare Service, was in charge. He and his aides first taught a group of "bomb throwers" the proper method of hurling the missiles to the best advantage. Then the rookies formed themselves into a "mob" about one hundred yards away from the police, and charged. They were permitted to cover about half the distance before the bomb throwing started.

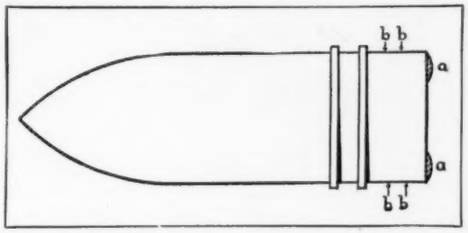
Four bombs then were hurled in the path of the charging men. The seven-inch rubber containers bounced once or twice and then exploded one after another, with sharp reports. Dense clouds of white vapor rose, spreading slowly in all directions to almost unbelievable volume. This soft white vapor, shifting before the light breeze, might have been a stone wall. It brought the "mob" to a dead stop within fifteen feet.

The mechanism of the bombs is extremely simple, and this is the feature that is expected to make them popular with the police and with paymasters who must travel lonely roads. They are exploded by a spring detonator that is generally set for five seconds, although this may be regulated to suit. This mechanism fits into a tube which is inserted into the top of the seven-inch rubber container after the latter has been filled with the charge of chemical compound. The spring is released by pulling a ring in the neck of the tube, so that, it is claimed, the bomb cannot go off until this ring is pulled, even though it is accidentally dropped.

When the bomb is to be thrown the ring is pulled with one's finger. But it is claimed that with a little practice a bank teller, for instance, could learn to snatch up one of the bombs with either hand and set

The police tear-bomb, showing its size in relation to the human hand

the spring with a slight pull of his thumb. He will then have five seconds to don a mask, or to jump for cover, unless in order to be doubly sure he has set the detonating mechanism to function at one second. A demonstration of the stunic gas within a building was given at the same time as the tear gas exhibition, four bluecoats offering themselves up for sacrifice. They



Two modes of applying the tin-lead alloy

were unconscious from five to ten minutes each, as only sufficient chemical was used to show its effectiveness.

The police are particularly hopeful that the bombs will be of value in chasing motor bandits. In every large American city this type of highwayman has been able to elude arrest again and again even when police

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75-millimeter shell, "metallized" by the Dagory process, and recovered after firing. The action of the metal is clearly indicated

Copper-Fouling of Ordnance Materials

By A. Dagory

THE importance of the phenomenon known of artillerymen under the name of "copper fouling" or "encoppering" was not revealed before the war. It was only after the heavy firing that took place on the French battle front from 1915 that it proved to be so important and that its serious consequences were fully realized.

We give a brief statement on this phenomenon and a description of the remedy that was adopted after long and fruitless attempts suggested by several inventors. The simple process by which the difficulty was overcome was presented in 1916 by the author of this article.

After a number of shells have been fired, said number being variable according to type of gun, a certain amount of copper scraped off the copper driving-bands of the projectiles adheres both to the grooves and walls of the gun tube. Such deposits firmly stick to the bore and if the gun goes on firing, their thickness soon becomes so great that they affect the behavior of the shells and this to such an extent that their influence is most injurious. The effects of said injury can be summed up as follows:

(a) Part or total impairment of the rifling giving rise to considerable irregularities in firing ranges.

This defect is so great that with copper-fouled 32 mm. guns there is a serious shortening of the range. Sometimes, even, the shell "tumbles" along its trajectory.

(b) Bursting of the shell in the gun bore, due to a premature working of the fuse caused by the retardation of the shell speed, as it passes through the most copper-fouled portion of the bore.

In this case the bursting of the projectile generally involves the bursting of the gun itself.

(c) Increase of the gun wear due to the increase of friction of the driving-bands.

During the war it often happened that big guns were put out of service through encoppering after having fired but 350 or 400 rounds. The output of ordnance materials was thereby considerably impaired. At a certain time this situation became very serious.

The principle of the solution suggested in October, 1916, is the following:

A metallic mixture formed of a tin and lead alloy, in the proportions of 63 per cent tin and 37 per cent lead, is applied on the face of the bottom part of the shell. This composition is laid in a circular manner near the circumference of the base as shown at a, a; or, if preferred, it can be fixed around the shell to the rear of the copper driving band at the place marked b b. This tin-lead alloy can be applied in the form of rings fixed into place by soldering or better still by means of the Schoop spraying system.

Under the influence of the high temperature generated by the powder gases (this temperature exceeds 3500 deg. Fahr.) the tin-lead alloy immediately melts, its melting point being 370 deg. Fahr., and, owing to the extremely rapid rotation (several hundred revolutions per second) imparted to the shell by the grooves, this liquid alloy is thrown on to the walls of the bore in the form of thin drops.

When it comes into contact with the copper already deposited in the grooves, etc., tin forms with this latter an alloy melting at the temperature of the gun, this alloy being readily expelled by the passage of the following shells. Copper is thus dissolved by the tin. As to the lead, which is a plastic metal, it adds a lubricating effect to the chemical action of tin.

A few shells (3 or 4 for big guns and 15 to 20 for field guns) are sufficient to remove the entire copper obstructing the grooves of a fouled gun and by continuing firing shells provided at the bottom with a tin-lead composition, copper-fouling is definitely avoided. It is, of course, the same when this process is applied to new guns.

The photograph annexed hereto shows the base of a projectile which has been covered, purposely, with a thicker coating of tin-lead alloy than necessary. This shell, unloaded, has been fired on a proving ground and found after firing; tin-lead alloy melting is clearly visible, as well as traces of the projection of the thin drop of melted metal.

The fixing on the shell of the tin-lead alloy can be carried out in several ways. For instance, suitable rings or collars can be made in advance to the proper size with the above alloy and welded into place on the projectile. It should be noted however that the most rapid process and the one giving the best results is that known as the Schoop spraying system.

This process has now been used for years in industrial practice as far as zinc, lead and copper plating

(*Continued on page 216*)

A Problem in Levels

How the Shafts and Workings of Coal Mines Are Kept Free of Water

By J. F. Springer

THE miner has always been troubled with the matter of getting rid of the inflowing water. This has been especially the case in Great Britain in connection with the mining of coal. Here in the United States the water-removal problem in the case of coal mines has not been acute over the country as a whole. The reason for the difference lies in the geological placement of the coal strata in the two countries. In Great Britain the coal lies deep down, while in the United States it is generally at a slight or moderate depth below the surface. However, in the anthracite regions, Americans frequently have to put down fairly deep shafts to reach the coal beds. It is, apparently, in connection with such mines that the tank system for the removal of water has been developed. This consists briefly in lowering an empty tank into the depths below, filling it with water, hoisting it to the surface and then discharging the water. It is, for all the world, like getting water out of a well with rope and bucket. In principle, then, the idea is most ancient.

A modern plant, however, for the removal of water or the performance of almost any duty, immediately runs up against the necessity of making good economically. There are several ways of getting water out of a mine. Generally, some method is used which depends upon a pump, working with more or less continuity. Pumps never discharge large quantities of water in an instant of time, but they derive their efficiency from being "everlastingly at it." As a rule, continuous operation is a principal factor in the efficiency of numberless modern mechanical devices.

A water tank may weigh a very considerable amount —17,000 pounds may be taken as fairly representative. The quantity of water will weigh 30,000 pounds. This is equivalent to 3600 U. S. gallons. In addition to the 47,000 pounds of tank and load, one must think of the steel cable reaching down to the bottom. This must be hoisted too, although as the tank comes up the cable weight diminishes. In the present case the steel rope would probably be 2 inches in diameter and weigh 6.25 pounds per foot. Every 1000 feet of depth would accordingly mean 6250 pounds for rope weight. On the other hand, where hoists are operated in pairs, the mode of operation may be such that as one tank comes up with its load the other descends empty and acts as a counterweight. The actual work to be performed by the steam engine or electric motor may thus be greatly diminished.

In Panther Valley, Pennsylvania, not far from Mauch Chunk, a celebrated variety of anthracite has been mined for years. In this region there are perhaps eight installations of tank hoists. At Coaldale No. 8 and Lansford No. 6 shafts are two old water hoists. They are, perhaps, the very oldest in the anthracite region. Another shaft, Coaldale No. 9, has a water hoist, but the water is discharged before it gets to the surface. It is, in fact, poured into a water level tunnel located below the head of the shaft. The reader may be particularly interested in a pair of water hoists located at Tamaquah Colliery, Shaft No. 14. Here there is electric motive power as well as steam.

At some of the shafts the water brought up from below is used in what is called the wet preparation of coal. As the coal breakers are situated at lower levels than the reservoirs at the shaft mouths, the water may be, and is, run to them by gravity.

At No. 14 shaft the two water hoists have the duty, in normal times, of taking out all water. There are shafts, A and B, of which A is for the removal of water. It is about 826 feet deep. A short tunnel runs off in one direction from a level near the bottom. This is the sump tunnel. It cuts across several layers of strata, which are here very steeply inclined. As an example of what the two hoists here are capable of, one may cite the record for March, 1917. In that month 29,000 tankfuls of water were hoisted. This amounts to something like 88,000,000 gallons.

Shaft No. 14 is divided into four vertical compartments, each 8 x 8 feet in plan section.

A steel tank used in the electric hoist will be an upright cylinder of steel plate. The diameter inside is 5 feet 9½ inches, and the diameter outside is ¾ inch greater. The thickness of plate is, accordingly, ¾ inch. The over-all height is about 28½ feet, but only about 19 feet, or perhaps something less, is available for holding water. At the top are the four chains which are secured at quadrant intervals to straps riveted on the tank body. These chains are short and serve as a means of lifting the whole at a point in the central axis. At the lower end of the tank is arranged a spout through which the water is received and discharged. Above the spout and inside the tank are two flap valves. These valves open upward. Naturally, when the tank is full, they are held closed by the gravity of the contained water. However, there is a chain arranged in the position of the axis which connects at its lower end by two branch chains to the two valves. Above, at the top of the 19 feet of water cylinder, is a small wheel around which the main chain runs. A balance weight is secured to the end. It will readily be understood, perhaps, that if, when the tank full of water arrives at the top of the shaft, the wheel is turned properly, the valves will be opened and water discharged. To provide for this, a pawl is arranged to operate the wheel and it is made to do its duty by means of a fixed guide against which it strikes when the tank comes to the desired level in its upward movement. When, upon its descent, the tank enters the water in the sump, the valves will open because of the weight of the tank and the resistance of the water. The counterweight mentioned will naturally keep the chain stretched.

These tanks run up and down very rapidly, the speed at Shaft No. 14 being, for the electric hoist, about 1080 feet per minute. However, on a lift, there will be a period of getting up to speed, say, 12 seconds. This will be followed by a period of running at full speed, which will be, say, 79 seconds in length. As the stop is approached the speed is retarded, say, for 6 seconds. Then there will be a rest period of perhaps 15 seconds. The total upward movement will thus occupy, say, 112 seconds.

Naturally it is highly desirable to know in advance just how much current a hoisting plant will consume. In the present case the coal company furnished one of the great electric equipment concerns with figures covering the duty to be performed. The reply was to the effect that the current consumption required per dufy cycle would amount to about 15½ kilowatt-hours. After installation, the coal company set down the total number of trips made in 1 year's operation and divided this into the number of kilowatt-hours consumed, with the result that it was found that the equipment company had made no mistake.

Left: Example of a vertical hoist used for lifting water from the shaft. *Right:* A closer view of the business end of the same outfit

The up-to-date plant for freeing a mine of water

Mention has been made of the speed at which the hoists run. It is necessary that the tank shall follow a very precise path both rising and descending. This is provided for by means of vertical guides arranged to form with other framework a kind of elevator well. The tank has secured to it on diametrically opposite sides a number of shoes which engage with the guides.

Some actual experience with the water hoist may be of interest. Some years ago, as Mr. F. E. Brackett tells us in an account, the pumping plant at Coleman Shaft, Cambria County, Pa., was unable to function, and the water tank method was employed as an emergency measure. This shaft is some 660 feet deep and gave trouble during its excavation because of the water admitted by it. At the time when the trouble with the pumping plant occurred, water was filling the mine, partly from the shaft and partly from the mine itself, at the rate of 800 gallons per minute. The pumping chamber was out of reach and would remain so until the level of the water in the mine could be lowered. Two water skips which had been purchased for use in case of an emergency were available. Each had a rated capacity of 1200 gallons. First, one of the skips was put in place to use. This required 10 hours. It was operated from 9 p.m. until the following morning

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Water Power in the Household

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Present form of water motor employed by a French experimenter, and, at the right, his first attempt at a rotor, made with ordinary spoons

As far as the United States is concerned, the water motor has come and gone. At least, it was quite popular some ten or fifteen years ago, at a time when electricity was not available to the extent that it is today. The small electric motor has no doubt replaced the water motor and rendered the latter obsolete except in such households and shops where electric current is not at hand, but where high pressure water supply is available.

In Europe, however, there is still a field for the water motor, especially for light tasks about the household or small shop. Not so long ago a Frenchman, M. Colardeau, attracted no little attention by his application of water power for the generation of electricity used in lighting his home. It appears that M. Colardeau works on the principle that it is more economical to tap the waste and drain pipes of the household than the metered water supply, and makes use of a small storage battery for receiving the periodic supply of electricity, which he thus stores and draws upon as desired.

The accompanying photographs represent M. Colardeau's water motors. His first attempt took the form of a shaft and hub on which he mounted a number of ordinary spoons after the fashion of a paddle wheel, as shown. Later, he developed a more practical water wheel as shown at the left of the upper illustration. The water wheel, which is the rotor of the water motor, spins in a brass casing which is provided with an inlet and an outlet pipe. A glass face, mounting a brass bushing which serves as a bearing, enables one to notice the action of the rushing water and the spinning rotor.

The second illustration shows the compact little power plant developed by this ingenious Frenchman. He is evidently making use of a magneto type of generator which is sometimes seen in laboratories because of its simple, elementary construction. The water motor is also employed by M. Colardeau for driving a small lathe, through a reduction gearing.

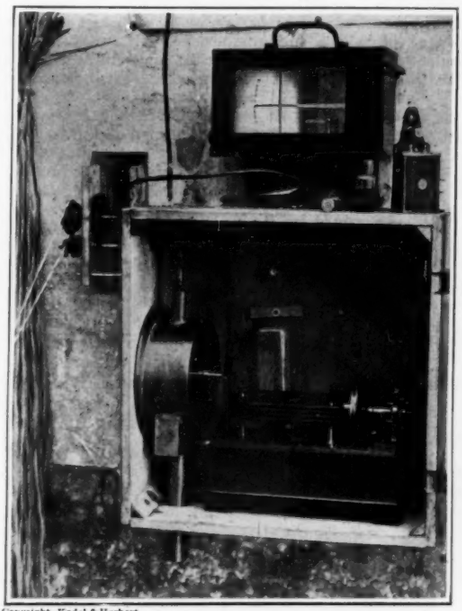
Potash from Texas?

SAMPLES of salts recently sent from western Texas to the laboratories of the United States Geological Survey, Department of the Interior, at Washington, D. C., and of the Texas Bureau of Economic Geology and Technology at Austin, Texas, contain percentages of potash that suggest at least the richness of the potash deposits of Alsace and Germany. The samples were obtained from two borings about 80 miles apart, sunk by oil companies in the "Red Beds" region of Texas, where salt beds, red shales, gypsum, and other materials are associated in strata of nearly the same geologic age and general character as the potash-bearing beds of western Europe. The thickness of the potash-bearing beds in Texas represented by these samples is unknown, however, and the questions remain to be determined whether the deposit is thick enough to furnish potash in as great amount and of as high a grade as those in Europe, or whether it is of scientific interest only and mainly important as showing that potash-rich salts were actually deposited in this region and that other borings in areas where similar beds occur may discover commercial deposits.

For several years the United States Geological Survey and the Texas Bureau of Economic Geology and Technology, working in cooperation, have maintained in the field an examiner to keep in touch with companies that are drilling for water or oil in the great "Red Beds" region of western Texas, eastern New Mexico, and western Oklahoma. So far as practicable the drilling has been followed by this cooperative representative, who has made rough field tests of drill cuttings and brines in a search for evidence that the drill had struck beds of salts rich in potash and has sent samples that appeared to deserve thorough chemical analysis to the chemical laboratories of the cooperative bureaus. The problem of recognizing the presence of a thin bed of potash salt, of determining its thickness, and of identifying its precise position in the stratigraphic column is rather difficult, however, on account of the adverse conditions of observation, the methods of drilling, and sometimes the indifference of the driller. Among the samples recently examined by D. D. Christner, the present cooperative representative at Amarillo, was one from the Bryant well, in Midland County, Texas, which as shown by a rough field test, is very rich in potash. Subsequent accurate determinations in the laboratories of the State University and of the Geological Survey in Washington showed that this sample, which was saved by the driller from cuttings taken at depths between 2405 and 2525 feet, contained about 9 per cent of potash (K_2O). The sample consisted of red salt, including polyhalite, white salt, crushed red shale, and mud, so that the fragments of red salt ground up in the cuttings probably represent a layer that is richer in potash even than the sample as a whole.

A small piece of red salt brought out from a depth of about 1864 feet in the Burns No. 1 well of the La Mesa Oil Co., which is about 80 miles from the Bryant well, contained about 10 per cent of potash (K_2O).

Information as to the probable thickness of the bed represented by the sample of potash salt is lacking.



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Water motor and simple magneto type generator employed by M. Colardeau for lighting his home

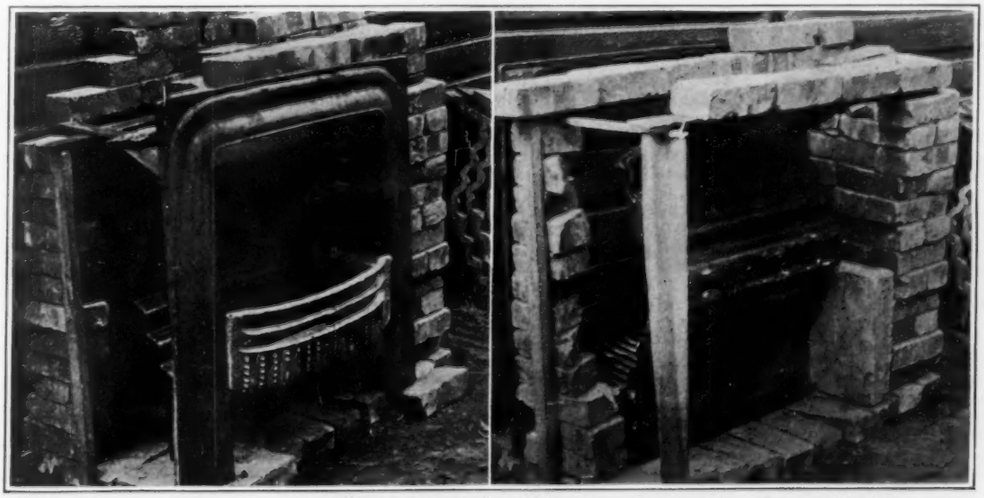
More Heat from the Fireplace

A PATENT has recently been applied for at the U. S. Patent Office for a fire-back that can be built in an ordinary chimney, or even installed in one after it has been built. It is claimed that this device will save one-half of the usual fuel consumption or more. It is so simple that it may be installed by almost anyone.

The fire-back, which is shown in the accompanying illustrations at the bottom of this page, is simply a solid V-shaped piece of corrugated casting that fits snugly in the back of the fireplace, and takes the place of brick. Therefore, when the fire is made in one room the casting becomes hot and radiates heat in another room that backs up against the first room, providing the fireplace is cut through so as to expose the reverse side of the iron fire-back. Also, to increase the efficiency of this device, flues may be constructed in the chimney wall opening into the sides of the fireplace and communicating with the chamber behind the fire-back in the other room. This chamber is provided with asbestos screen, which can be lowered or raised. When lowered, heated air will be conveyed to an upper story. It can readily be understood that this arrangement furnishes an ideal way of ventilating, since the intake flue contacts with the hot casting. There are registers just above the baseboard in the upper rooms.

The fire-back, being V-shaped, can expand and contract and thus will not crack from heat, so it is claimed. Furthermore, it has a sufficient thickness to render service and to radiate sufficient heat. In the event that one of these fire-backs should burn out, they are about as easily replaced as a fire-back in a stove. Each fire-back weighs in the neighborhood of 200 pounds.

There are numerous advantages claimed for the new fire-back, which is the invention of Robert Goff of Gary, W. Va. To begin with, its inventor estimates that it will save at least 500 brick, besides the saving in other materials and in labor. It also saves the expense of other grates and fronts. With this fire-back one fire is built instead of two or more. There are no coal or ashes to be carried up and down stairs. There are no fires to watch. Tests show that with this system the temperature does not rise and fall as much as with an ordinary fire, but remains at a very comfortable heat which makes the upstairs rooms ideal as sleeping rooms. All in all, it must be considerable satisfaction in these days of high coal costs to know that one fireplace is serving to heat several rooms without burning more fuel than usual.



Front and rear views of the newly introduced fire-back which makes the usual fireplace considerably more effective without additional fuel consumption

The Lesson of the "ZR-2" Disaster

Some Recent Facts Bearing on the Construction and Tests and the Conclusions Drawn Therefrom

By Ladislas d'Orcy

THE two chief questions which, in connection with the accidental destruction of the rigid airship "ZR-2" (or "R-38") come to the mind of the average person are:

1. What was the matter with the "ZR-2?"
2. Was her purchase by the United States Navy justified?

While it is yet premature, pending the findings of the official inquiry, to state with finality what caused the terrible disaster, it is not difficult to visualize what went wrong with the "ZR-2." Statements by survivors seem to establish pretty definitely that the big airship broke in two not under the strain of full speed trials, as had first been assumed, but that the longitudinals snapped when the helm was put hard over. The commander of the dirigible, who was rescued, has declared that at the time of the accident the ship was making 50 knots—as against 65 knots "all out." On the other hand, another survivor, Lieutenant Bateman, states that just prior to the accident the ship had made turning tests, and that two turns had been managed without difficulty, but that on the third the vessel broke her back. His statement is particularly significant in view of the fact that he was able to observe the working of the rudders as he was seated in the stern cockpit, which is aft of the rudders.

So it becomes rather obvious that the ship was turned too suddenly for the speed at which she was flying, although this maneuver might have been totally harmless at a lesser speed.

There is still a further point to be considered: information reaching this country from men who were in close contact with the development and trials of the "ZR-2" shows that her control surfaces were overbalanced. That is to say, the balanced portion of the rudders was so large that they were extremely sensitive to air pressure, so that when the ship was under way a slight turn of the steering wheel would suffice to whip about the rudders. At high speed this would naturally cause a tremendous strain on the 700-feet-long framework.

It would therefore seem that the design of the "ZR-2's" rudders was faulty. This defect, which might have been easily remedied, would not have been a serious matter on a stronger ship. But the "ZR-2," far from being a strong ship, was what one may call an "extra-light" vessel—a feature which borders on structural weakness. To understand the why and wherefore of the situation we must look at the history of rigid airship development, which takes us back to Count Zeppelin.

Germany launched her first "super-Zeppelin," a 2,000,000 cu. ft. vessel, in 1916, after fifteen years' experience in this branch of engineering, in which period she built some *sixty* Zeppelins ranging all the way from 400,000 cu. ft. to 1,250,000 cu. ft. In the fall of 1916 one such super-Zeppelin, the "L-33," was brought down fairly intact in England and the British Admiralty instructed its airship designers to duplicate it. Up to that time British experience in rigid airship design and construction was limited to that obtained from a number of experimental ships that were being built after very incomplete drawings of pre-war Zeppelins. The British copy of the "L-33," called the "R-33," was only finished after the armistice, her trials taking place in the spring of 1919. Although the vessel embodied some improvements found in another captured Zeppelin, the "L-49," which had come down intact in France, it should be pointed out that while the latter ship had a useful load of 39 tons, and the "L-33" one of 30 tons, the British copy of these 2,000,000 cu. ft. dirigibles had only a useful load of 24 tons. All of which is merely mentioned to show that a painstaking copy of an engineering structure will not necessarily be identical in all respects with the prototype—although they may *look alike*.

But while the "R-33" carried a smaller useful load than her German sisterships, she seemed to be in every way as strong as the latter. How strong the hull of these ships was, the "R-34" (sistership of the "R-33") demonstrated at Mineola, Long Island, where for four days she withstood buffeting by winds, although on one occasion the anchorage fitting of the main handling rope was pulled clean out of the framework.

The success of the "R-33" class airships prompted the British Admiralty in 1918 to prepare drawings for a much larger class of airships which were to be superior to the German "L-71" type. This was the ill-fated "R-38" (the "ZR-2," as we call it) class, which incorporated numerous novel and original ideas. Now, it should be emphasized that when this class was *laid down*, all the experience the British had in rigid airship construction had been derived from copying German ships. The only firm which eventually was to produce a highly successful original design (Vickers, Ltd., with their "R-80") had not by then emerged from the experimental period of their work; their experience was therefore unavailable.

And what may strike the reader as particularly odd, the Admiralty gave the contract for the construction of the "R-38" (or "ZR-2") to Short Bros. of Bedford—*a firm that had never before built a Zeppelin type airship* and whose entire experience with rigids was obtained from the building of "R-31" and "R-32," which were patterned after the *plywood-framed* Schuette-Lanz type.

Here then we have, in part at least, the answer to the question which heads this article: What was the matter with the "ZR-2?" *The ship was built in a factory that had no previous experience with duralumin airship construction, and to plans which were not based on practical experience.* To cite but one instance, the well-proven radial truss of the transverse frames was replaced on the "ZR-2" by a tangential truss system, the merit of which had yet to be demonstrated. In this connection I cannot do less but pay a respectful homage to the memory of the late Colonel Campbell, chief airship designer of the Admiralty, who had sufficient faith in his ideas to go up on the "ZR-2" during her several trial trips and who lost his life with the ship.

Knowing the circumstances which surrounded the construction of the "ZR-2," we begin to understand why, as one report has it "several girders were strained in the factory when as many as thirty fitters crowded on them in the course of assembly work." It is quite conceivable that workmen accustomed to the resiliency of plywood girders would do just such a thing and that their foremen, not knowing any better, would not warn them. And a 700-foot airship is such a gigantic structure that the engineers familiar with the vagaries of duralumin—whom the Admiralty had detailed to the Short Works—could not personally supervise every detail.

For the sake of completeness it may be added that when Messrs. Short Bros. closed down their airship department, the Admiralty took over their factory and completed the "ZR-2," whereupon she was handed over to the British Air Ministry.

That the hull of the "ZR-2" was structurally weak was first demonstrated on the inflation of the ship when, due to unequal load distribution, several girders buckled. The failing members were repaired, but during the first trial flight trouble was again experienced from several intermediate longitudinals and transverse frames, so that it became necessary to reinforce certain portions of the framework. Details are not available as to the exact nature of this stiffening work, but one might suggest that by reinforcing certain girders others may have been further weakened. Of course, this is merely a guess.

Judging however from all that has been said before it appears beyond a doubt that the "ZR-2" *was* structurally weak—a condition brought about by the desire to carry the greatest possible useful load. This, as originally designed, was to be in excess of 50 tons, but it was subsequently reduced by the fitting of a bow mooring gear, not to speak of the reinforcement of the hull.

As to the second question we have placed at the head of this article: "Was the purchase of the "R-38" by the United States Navy justified?"—it would seem to the impartial observer that it was not.

Indeed, why should the Government spend abroad $2,000,000 on a foreign-built, untried type of dirigible?

On the one hand the Navy is desirous of developing rigid airships in this country. This can be brought about only through experimentation, and it will be admitted that if the necessarily heavy financial outlay has to be faced it will better serve its purpose if the money is spent here rather than abroad. American inventive genius is second to none in the world and can be relied upon to solve the problems of rigid airship construction just as well as it has solved other engineering problems.

On the other hand, if the Navy Department—which is in charge of rigid airship development to the exclusion of the Army—wanted to have a ready-made airship of proven design, it would seem that it could have secured from Germany, without cost, by virtue of America's participation in the victory—a dirigible that would have been far superior to the "R-38." This will be seen from the appended table which gives the chief characteristics of the "R-38" and of the "L-71," Germany's largest Zeppelin, which was surrendered to Great Britain, while her sistership, the "L-72," was surrendered to France:

Type	Capacity cu. ft.	Length ft.	Dia. ft.	Total H.P.	Useful Load (tons)	High Speed Miles per Hour
"R-38"	2,720,000	695	85	2100	50(?)	75
"L-71"	2,420,000	745	79	1740	48	75

It is not generally known that while the war spoils of the United States include a great number of airplanes and engines, the lighter-than-air material of Germany was entirely divided up between Great Britain, France, Italy and Japan, the United States merely playing the role of a disinterested spectator. That this was a grievous mistake, will be readily conceded by all those concerned with the development of American airships.

AS we were going to press with a past issue we learned of the terrible disaster which overtook the "ZR-2" dirigible during the trial flights. We promised more details regarding the cause of the collapse of what we were given to understand was the very last word in airship design and construction. And we have fulfilled our promise by asking Mr. Ladislas d'Orcy, who will be recalled as the writer of many of the aviation articles that have appeared in past issues of this journal, to study the disaster and explain it to us in simple terms. Not only has Mr. d'Orcy explained the reasons for the disaster, but he has drawn several conclusions which should serve as a guide to future efforts in dirigible construction, both here and abroad. Incidentally, it may be mentioned that Mr. d'Orcy is Editor of the "Aviation and Aircraft Journal," one of our leading aviation journals.—THE EDITOR.

The Psychology of the Show Window

SOME very interesting experiments have recently been carried out at the Institute of Business Science, connected with the Commercial High School at Mannheim, Germany, concerning the psychology of the appeal made by window exhibits. The experiments were made at a large specialty shop catering to women. This shop had 15 show-windows fronting on two streets located near a main artery of traffic. In some of the windows the articles bore price tags, while in others they did not. In some one color alone was used and in others a variety of shades; again, some windows contained nothing but the articles on sale while others had picturesque settings and accessories. The results of the observation were quite striking and some were unexpected as we learn from *Die Umschau* (Frankfurt) for Dec. 25, 1920:

Dr. Lysinski of the Institute, who conducted the experiments, states that the sales of those displayed articles bearing a price label greatly exceeded that of articles not so marked. Likewise windows in which articles of various colors were shown seemed to have a greater drawing power than those in which a uniform color was used. As a usual thing greater sales were obtained from windows displaying a large variety of articles than from those showing only a few; the results varied, however, in this case. Most remarkable is the fact that those windows having decorative accessories proved to be much less effective than those without decoration. This last observation is well worth the attention of American merchants, since there has been a considerable development in this country of purely decorative features in window dressing during the last few years.

Group Medicine

A Recent Development in Medical Practice Which Groups Specialists for Diagnosis and Treatment

By Mary Ethel Jameson

SIR JAMES MACKENZIE, writing on the future of medicine, has said that medicine is becoming so complex that the general practitioner's knowledge of any particular disease is bound to be less than that of the man who devotes his whole time and energy to the understanding of that disease; and that the methods used today for the detection of disease have become so numerous and recondite that it requires special training to become adept in their use.

It seems to be a recognized fact, then, in the medical profession, that in many cases it requires the training of more than one man and more than one specialty before a true interpretation of symptoms can be reached. The physician constantly feels the need of help from associate specialists as evidenced by the practice of referring the patient to physicians in other branches of medical science, but frequently the fees of several specialists are beyond the financial reach of the patient.

Nevertheless, he is entitled to a differential diagnosis when it is possible by collaboration to determine the nature of a diseased condition before treatment is undertaken. This is not always practiced and patients are frequently victims of months of mistaken treatment before a specialist is called who finally determines the cause of the suffering.

The present advances of medical science demand a revision of medical practice and the transitional state is upon us. One development most prominently demanding consideration is what is called Group Medicine.

Medical journals are, at present, abounding in articles relating to Group Medicine, detailing procedure, the specialties represented, the clinics being organized in various parts of the country, and arguments pro and con this method of practice. The layman on the other hand, were he asked to define the Group plan, would probably reply that it referred to a group of public buildings surrounding a public square.

Groups are generally formed for both the diagnosis and treatment of disease. This is the ideal plan, although some few clinics have been organized for diagnosis alone. The group is made up of a number of physicians who are specialists in different branches of medicine. Through this arrangement each member physician has at his disposal all accessory therapeutic agencies, and the training and experience of all the other members.

The Group should comprise at least, an Internist, an Ophthalomologist, an Oto-laryngologist, a Roentgenologist, a Surgeon, an Orthopedist, a Urologist and Gynecologist, and a Laboratory Pathologist.

The patient first consults the Internist who takes a complete history of the case, making a written record of all previous illnesses and hereditary tendencies. After making a thorough physical examination, the Internist sends the patient to those of his associates who can give him light on the perplexing aspects of the case by special examinations and tests, eyes, nose, throat, spine, nerves, etc. Laboratory tests are made of the secretions, excretions, and blood; Roentgenograms are made of the teeth, the gastro-intestinal tract, and of the organs of the chest and abdomen.

The history prepared by the Internist is studied by each member of the group seeing the patient, and their observations are added to the record sheet with comments and recommendations. This report is finally returned to the Internist who reads the additional information contributed by his confreres and then a consultation is held, a diagnosis is determined, and the patient sent for treatment to the specialist properly qualified to treat the case or for surgical intervention. Hence, as Dr. L. F. Barker concludes, the Group becomes a glorified general practitioner. The axiom of Group Medicine is thoroughness. The development of synchronized work through daily consultation and collaboration is obviously beneficial to medical practice as to other branches of scientific endeavor.

As will be readily seen it is preferable that a Group should be housed under one roof in order to conserve the time of patient and physician and to assure all facility in consultation.

The medical profession is by no means entirely agreed that the general practitioner is no longer able to cope with the situation, but the laity have begun to see the evils of long delayed diagnosis, and to rebel against experimental treatment. They will soon realize the value of collaboration, and will demand the services of more than one doctor before treatment is undertaken.

The medical profession is not entirely agreed that Group Medicine is the best form of practice and where clinics have been established there is much criticism from the local profession. Nay, more, there is often actual hostility. This is to be expected, for the path of all pioneers has been a thorny one. It is not long since the Mayo Brothers were accused of unethical advertising because an overzealous patient burst into print in a description of the Rochester clinic. Today that clinic is the Mecca of thousands of patients, and is the ideal of the smaller clinics being established in all parts of the country.

The arguments against the Group form of practice are those of a superethical profession: commercialism, and exploitation of the patient.

It is an obsolete tradition that the physician should not be paid for his services, but why a group should be actuated by a greater desire for financial advancement than a single practitioner or a struggling young graduate who is willing to grasp at a straw, or otherwise a patient with a fee, is not quite clear. The economy of group medicine is evident where duplication of attendants and equipment is avoided and time is conserved. Where the usual fees for examinations by five or six specialists would total perhaps seventy-five to one hundred dollars, the Group diagnosis is

(*Continued on page 210*)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Excelsior!

To the Editor of the SCIENTIFIC AMERICAN:

Perhaps you will accept my offering as the latest addition to your collection of scientific gems. This one, you will please note, did not come from the columns of any mere newspaper; I find it in the January issue of what, next to your own organ, I have been accustomed always to regard as the best journal of popular science. The author from whom I quote gives a very presentable account of the way in which an ice-cream freezer accomplishes its mission in life by abstracting heat from the mixture inside the can to melt the surrounding ice. But he is not content to let well enough alone; he goes on to explain the role of the salt, as follows:

"The salt passing into solution in the water also liberates heat, and this quickens the process by making the ice melt more rapidly, thus more rapidly taking the heat from the container."

Doubtless I ought to comment upon the gentleman's discovery of what, for want of a better name, I suppose I may call the latent heat of solution; but the fact is, in the presence of such an epoch-making innovation as that indicated by the latter part of his argument, the mere enunciation of a new principle of abstract scientific theory pales into insignificance, and even perpetual motion becomes a trivial thing not worth striving for. I refer, of course, to the author's marvelous scheme of balancing two positives to get a negative. We have always understood that two negatives make a positive, but the reciprocal theorem is a new and unexpected demonstration. If we can't spend heat fast enough, get somebody else to spend his heat; if we can't run fast enough to catch our train, get the train to run away from us and behold we shall catch it. Last spring I had a bad flood in my cellar, due to the fact that melting snow and a driving rain brought the water in faster than the drain could dispose of it. Had I but been acquainted with the principle set forth in such lucid language by this modern Faraday, I should have run a line of hose from my kitchen hydrant across the lawn, to discharge into the brook which carries off the flow from my drain. The brook would have been swelled by this increment, and, if I read my authority correctly, the flood in my cellar would have been relieved by precisely this amount. STUPEFACTUS.

The Letter W

To the Editor of the SCIENTIFIC AMERICAN:

It will be noted that the letter W of the alphabet is the only letter, which in pronouncing, has more than one syllable. Pronouncing it as we do, dou-ble-you, it is noted that three syllables are sounded. Why not simply say wu, giving it a monosyllabic pronunciation same as the other twenty-five letters, This pronunciation would be more in keeping with the sound and force of the letter in the word where it is used.

Just spell a few words and note the difference: Way, double-you-a-y, wu-a-y; when, double-you-h-e-n, wu-h-e-n, and so forth.

It seems very impractical to pronounce a letter altogether foreign to its phonetic force; neither of the three syllables in dou-ble-you has the slightest relation to the phonetic power of the letter; wu seems to have almost if not entirely the full force or phonetic power.

Would not therefore wu, which is very simple, clear and short be a better and more logical pronunciation?

Again, in this day of simplifying and eliminating the unnecessary, why do we persist in always using the letter U as the second letter in every word beginning with the letter Q? There is not a single English word beginning with Q that the second letter is not U and there is hardly a word that would not have practically the same phonetic force without its use.

Hanover, Pa. ERVIN S. MUMMERT.

Electromagnetic Waves in Gravitational and Magnetic Fields

To the Editor of the SCIENTIFIC AMERICAN:

Three physicists, one of whom fortunately is now President of the Massachusetts Institute of Technology, have stated, as the result of their experiments, that light exerts a pressure. I used the word fortunate, because the best that can happen to a school of science is to have at its head an experimenter with an original mind, for progress depends on awakening in the minds of students a real love of experimenting.

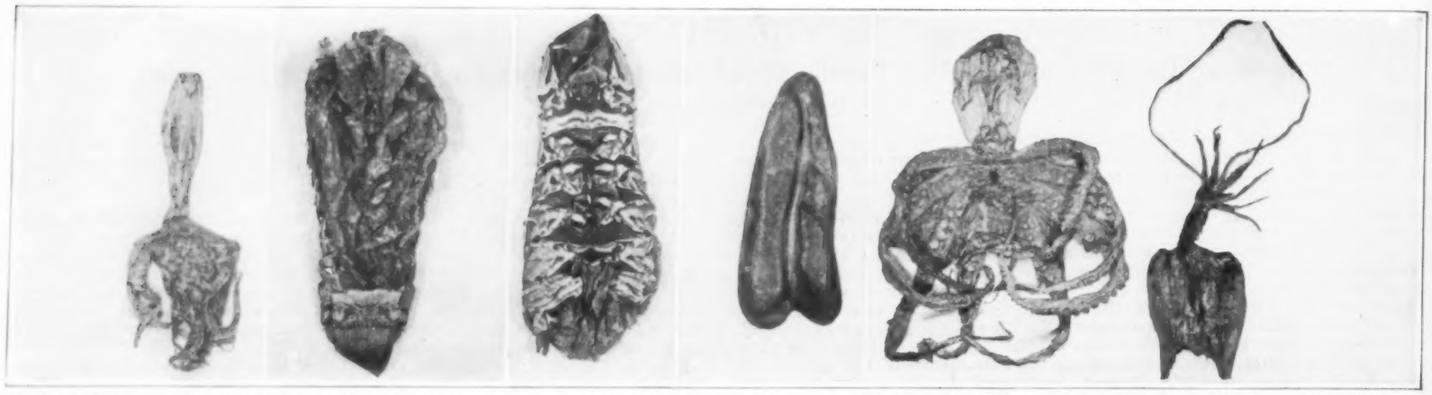
If Einstein's theory that light has mass and is therefore acted on by gravitational fields, was founded on an experiment, it was probably on those showing that light exerted a pressure. Now it is impossible for the experimental type of mind to visualize a wave except in a medium having mass, whether we call it the ether, the dielectric, the electromagnetic medium or simply space. Newton said that any man with a competent faculty of thinking must believe in a medium filling space. Maxwell and Hertz always visualized a medium in their work on waves. Faraday in one of his letters to his friend Phillips expressed himself as being able to do without an ether, yet his lines of force required a medium in which to function.

Any medium to transmit a wave must have mass, for a wave implies a displacement of mass. Any medium therefore capable of being thrown into waves must be attracted and attract, for all mass is gravitational. Therefore all electromagnetic waves, whether we call them X-light, visible light, infra red, or wireless, passing through the gravitational fields of bodies in space must be deflected, for the medium in the neighborhood of each must be denser. Why then attribute all the deflection of light observed during an eclipse of the sun to weight in the wave? Why ignore the part played by the medium transmitting the wave? Why neglect the effect on the electromagnetic wave of the magnetic field of the gravitating body past which the wave is advancing?

Another reason why an experimenter visualizes space as having mass is its vastness compared with the bodies seen in the telescope, revealed by the camera, and with that of the dark bodies surrounding them. He can only think of space as the residuum after their formation from Mother space. To him the only thinkable idea of mass is that it is condensed ether, and he correlates this easily with the theory that all mass is electrical by thinking that electricity is dissociated ether. That an electric generator is a machine to accomplish this. The idea that electricity is dissociated ether affords the simplest explanation of Faraday's electrostatic induction, the first glimpse of which we owe to John Canton. I end by mentioning a few statements by Faraday:

"We may hope to bring magnetism into a bond with gravity. I have a strong feeling of the existence of a relation between electricity and gravity. If there is an ether it should have other uses than simply the conveyance of radiations.

Tamworth, N. H. WILLIAM ROLLINS.



1. Dried squid from China, imported by the ton. 2. Dried lobster tails, a great delicacy among the Greeks, seen from above, showing scales removed to facilitate drying. 3. The same article from underneath, showing feet, etc. 4. The original Turkish kaviar prepared from the mullet. 5. The giant devil-fish, dried, on regular sale in the Greek stores. 6. The ten-tentacled ink-fish eaten fresh by the Italians

Strange creatures of the water that are eaten in Manhattan's immigrant colonies

Fish Stories That Are Stranger Than Fiction

Queer Creatures of Ocean and River on Daily Sale in Out-of-the-Way Corners of New York

By L. Lodian

FISHERMEN'S yarns are usually of such Munchausen veracity that the very announcement of them begets an incredible smile. By fishermen, we mean here anglers who fish for a pastime. But there are also many thousands who, by force of circumstance, "go down to the sea in ships." They, too, have their yarns; but here truth is stronger than fiction, and stranger, too. Their yarns can be read, so to speak, in the different fish-marts or markets of Manhattan, in our foreign colonies. Here you see the purely commercial in fishdom; and what you would scarcely believe if told, you can see with your own eyes almost every day of the year. We refer to the many queer fish products on daily sale in old Gotham town; and we illustrate a few of them direct from the actual exhibits as rounded up one fine morning.

The devil-fish tribe, big and small, dried and fresh, are never missing from the stores of the Italian, Greek, Spanish, Turko-Español and Mongol colonies of Manhattan. They range in size from the small squid to the giant cuttlefish—some of the latter are so huge that their tentacles or "suckers" reach out more than a dozen feet and could encompass an ordinary row boat.

The cuttlefish (or *kalamar*, as internationally known among the exotics) can also always be obtained, from one year's end to another, pickled and canned in its own ink. Opening a container reveals a murky, inky mass; but it is quite delectable—as choice as potted lobster. In fact, devil-fish flesh is at its best served up in this canned form, having already been steam-cooked, and can be partaken of cold as it is, or re-heated. The liquid is a reliable conservant; it is the same sepia which, in more concentrated form, has been in use since remote periods all over the globe, being particularly valued by architects and draftsmen for its permanency.

Sun-dried oysters are always obtainable at Mongol stores throughout the country. They never use canned oysters. The bivalves are sold either loose or in wreath-form, spitted on rattan, and circled (after drying) for hanging up in stores. They are never so satisfactory as fresh oysters. They are mouthed dry, as they are, or stewed.

There is also a curious oyster-oil sold; but this is in cans, necessarily. There is some oil in the oyster; and the *modus operandi* is to take the mollusk in heaps, when all but dried out, and subject it to the ordinary oil-press. It is really an oil in emulsified form, since the natural juice of the oyster, much concentrated, is there too. It is a dingy, brownish liquid, of a decided oyster flavor. It is used in the preparation of instant oyster-broth—just add boiling water to a teaspoonful—besides its uses as a condiment for salads, soups, et al. The residual oyster "cake" from the presses is braised in oil while still moist and used as food.

Oyster-flour, in impalpable farina-form, of a cream-white color, is a most creditable product, and is always obtainable. It is convenient for instantly-made stews, or oyster-gravy; or for sprinkling on thin bread-and-butter sandwiches.

Lobsters' tails, sun-dried, are a great delicacy with the Greeks, and are imported regularly. There is no reason why they should not be prepared and marketed by American lobster concerns; but our own folks know not of this demand.

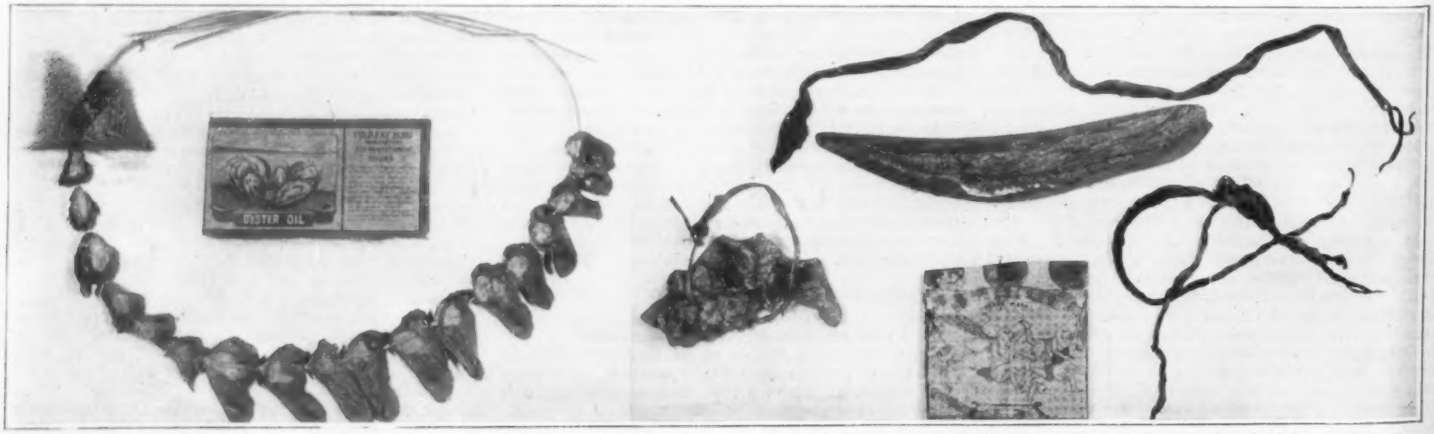
A capital, cleanly and tasty kaviar is imported from the Hellenes and all along the Asia Minor seaboard. It is the roe of the *bashra*—corresponding to our mullet fish—which is salted down, mild-cured and sun-dried to a firm compactness which makes the article almost as hard as wood. Then it is steeped in and given an effective coating of beeswax. This will preserve it for years, and the slightly fragrant beeswax-film will hold its faint honey-like odor for as long. This is the real original Turkish kaviar (from the Arabic *kabjar*). The Russian "kaviar" is just a name borrowed from the Arabic, and the word is only used by the Russians in conversation or correspondence with aliens. Among themselves, they call it *ikra*, which simply means *roe*. With its yellow beeswax film, this kaviar resembles somewhat a flattened banana. The interior has a refreshing odor and taste, and is ideal when cut into thin slices and served with sliced bread and sweet butter.

Then there is the giant single-piece kaviar-roe of the southern Italians and Sicilians. This is made from the big tuna fish. This big red-fleshed fish, with a body often the size of a horse, is often seen in the Mulberry plaza region. But since it is too unwieldy to take into the store, it is sold piecemeal from the wagon or truck kept standing off the curb.

The tuna-kaviar is sun-dried to a point where nobody would ever recognize it as a dainty relish for the lunch table. It resembles a piece of sun-greyed shriveled wood, appears as hard and falls with a thud like wood. The interior is dingy, yellowish, of most delectable and refreshing taste. The kaviar is bought as a whole, at a price of about three dollars a pound. It is never cut. The price ranges, according to the size, from four dollars to twelve dollars, or more.

A Japanese mackerel-steak, as imported, resembles a

(*Continued on page 211*)



1. Emulsified oyster-oil for flavoring. 2. Dried oysters from China, which are used as they stand, or stewed. 3. A choice cut of dried devil-fish. 4. The ossified mackerel steak of Japan. 5. Trade-mark from the last-named article, assuring the buyer that "a succession of illustrious sons" has made these goods. 6, 7. Eel skins, offered in many parts of exotic New York as a sure remedy for rheumatism

Some more of the curious fish-foods that may be found in the foreign shops of old New York

The Granite Gorge Bridge Across the Colorado

THE Government's slogan, "See America First," is a patriotic appeal to all of us to learn more about the beauties of the homeland before going abroad in quest of scenic wonders. And to make it worth our while to seek spectacular allurements within our own boundaries the National Park Service of the Department of the Interior is doing its utmost to make the ways of the tourist easy and pleasurable. One striking proof of this is in the form of a suspension bridge which has lately been thrown across the Colorado River in the Grand Canyon.

Because of the obstacles presented by physical conditions, the north side of Grand Canyon National Park, Arizona, has heretofore been well-nigh unvisited. Numerous difficulties of a discouraging and dangerous character have stood athwart the path of anyone seeking to cross the Colorado on horse or mule to reach the "north rim," as that section of the reservation is popularly termed. However, persons that have been courageous enough to make the long journey from railroad points in Utah have invariably been greatly impressed with the rugged and picturesque grandeur of the Canyon when viewed from there. The north rim affords observation from an altitude 1500 feet higher than any position on the south rim.

There was only one way to solve the problem of getting safely and speedily across the 420-foot gap at Granite Gorge, where the rocky walls rise nearly perpendicularly on both flanks of the river, and that was by the construction of a suspension bridge well above the swirling waters of the Colorado. While Granite Gorge seemed to be the place best suited for the bridge, still the erection of such a structure bristled potentially with numerous puzzling propositions. Nature showed no disposition to lend man a helping hand to link the opposite shores which had stood apart for countless ages.

A survey showed that the bridge would have to have a span of quite 500 feet and hold its floor aloft 40 feet above the general level of the river's surface. It was equally plain that the materials would have to be packed over trails for a distance of about ten miles and be carried down into the Canyon a matter of slightly over half a mile. To add to the toil and the risks, the paths are made up of a series of tortuous switchbacks, and in many places the grades exceed 40 per cent. It was realized from the start that these circumstances required that the structural units be as light as possible consistent with the strength and the service demanded.

To insure the needful sturdiness, two main cables of special tramway plow steel were decided upon, each wire rope being ⅞ of an inch in diameter. Together, these cables actually weigh 1790 pounds and they measure, from end to end, 550 feet a piece. The question was how to get these heavy hawsers to the building site. Originally, the plan was to apportion the load of a single cable among four mules by winding the wire rope into four pairs of associate coils—each mule carrying two of these coils and the four animals being strung together with 20 or 30-foot lengths of cable between them. The intention was to place each animal in the charge of a packer with intermediate men who, besides leading the mules, were to control the intervening slack when negotiating the switchbacks.

Further study showed that this procedure would hardly answer, and, in fact, it was considerably modified during the execution of the work. The problem was solved finally by Superintendent D. L. Raeburn by placing a mule at each end of the cable and loading them separately with coils weighing 200 pounds. The remaining 495 pounds of hawser was divided among 15 men who walked 20 feet apart, the individual burden averaging 33 pounds. Reporting upon the exploit, the superintendent says: "From our experience in dealing with the sharp turns on the trail, I am fully convinced that it would have been impossible to pack the whole length of the cable on mules. If attempted, the train would certainly have come into the ditch and the cable would have been badly kinked and ruined."

The preliminary work was begun at the bridge site last December under the auspices of Engineer O. W. Childs, who established his camp at the foot of Bright

(*Continued on page 212*)

The wreckage of the "ZR-2" in the Humber River, near Hull

The Wreckage of the "ZR-2"

THE various photographs of the wreck of the "ZR-2," which have just come from England, are far from spectacular, considering the quite spectacular and unfortunate ending of the great airship which was to be flown over the Atlantic to Lakehurst, N. J., for the use of the U. S. Navy. Indeed, instead of a huge structure of crumpled aluminum framework and loose folds of balloon fabric, the photographs show but a small amount of loose wreckage, such as that shown in the accompanying illustration. Indeed, nothing could better demonstrate the insecure construction of the usual rigid dirigible than this and other photographs, which show the framework completely broken up as the result of the collapse of the framework, the explosion, and finally the impact with the water. The dirigible retains its shape under normal conditions, but undue strain crumples it up into many little pieces.

Left: **The new bridge from up the trail on the south side of the Colorado.** ***Right:*** **Packing bridge timbers by mule train down to the bridge site**

When Electricity Fires the Enamel Ware

How the Electric Furnace Has Been Introduced in the Art of Vitreous Enameling With Excellent Results

By C. W. Mehling and Jas. W. Carpenter

ONE of the most momentous improvements of recent years in the art of vitreous enameling has been made with the application of the electric furnace to the heating work of enameling. The use of electric current for heating in steel and non-ferrous furnaces, in japanning, core baking, oil tempering and similar industrial operations has now been extended to the enameling process. This represents an interesting advancement over the previous ways of heating with coal, oil, or gas furnaces, and the electric installation here described has been operating for a sufficient length of time to demonstrate its practicability and its supremacy over the other types of furnaces.

Of the older methods of obtaining temperatures of from 1500 deg. to 1800 deg. Fahr. required for satisfactory enameling work, brief reference may be made to the disadvantages and troubles which have been encountered in the operation of such furnaces. With regard to the coal furnace it may be pointed out that in order to keep the temperature of 1700 deg. Fahr. it is necessary to employ an expert fireman, and even so there are times when the wind and atmospheric conditions, which have considerable to do with the draft, make it impossible, even with the very best of firing, to procure and maintain this high, constant temperature.

The most serious defect which has been encountered in the coal furnace is the muffle which periodically sags and breaks, thereby causing damage to or loss of ware by allowing the rack rests to go down. Regularly, at intervals of from two to twelve months, it is necessary with a coal furnace to renew the muffle and overhaul the firebox and furnace. This usually means a shutdown and loss of production of from two to four weeks. Moreover, in the coal furnace the sulfur fumes which are injurious to the ware and frequently cause a high percentage of seconds or of job lots, are so difficult to eliminate that a certain factor in production must ordinarily be allowed for the damaged output which will be obtained from the ordinary furnace.

The oil furnace and the gas furnace have the same drawbacks as the coal furnace. They will not hold the heat in burning large ware, and the bottom of the muffle burns out even faster than it does in the coal furnace. Likewise, the great variation in temperature between the front and rear ends of the oven usually reduces the actual space which may be productively used in burning. Such ovens are handicapped by the time required to bring them from a cold condition to operating temperature, and part time operation is practically impossible. Also the fuel supply of coal and oil furnaces is dependent upon railroad and labor factors which are not entirely dependable. The space occupied by the older ovens is greatly increased by the fuel storage room needed.

In sharp distinction with the preceding faults of the older type furnaces, it may be indicated that in the electric furnace there is no trouble with the muffle and the subsequent loss of ware by the falling rack rest, since the electric furnace has no muffle and the rack rest is built right up from the foundation. Furthermore, the even distribution of heat is a feature which can be obtained only by the electric installation and the furnace can be loaded from the rear wall right up to within six inches of the door and burned down to a finish, and the operation leaves a clean white enamel without spot or mar. Atmospheric conditions, of course, have no influence with the electric furnace as it needs no draft. Let the weather be what it will, it is your obedient servant providing sufficient electric current is available for its operation. Set the furnace to operate at 1700 deg. Fahr. and you will have 1700 deg. Fahr. regardless of the sunshine, rain or wind.

The cost of the electric furnace is, obviously, considerably higher in original investment than any of the other types, but the difference in maintenance cost, saving in space and cleanliness soon make the difference in price a matter of secondary importance. The fuel cost on an hourly basis for the electric oven is likewise higher, running nearly double that of coal, gas and fuel oil for 24-hour day operation. However, the additional output of the electric furnace as determined by relative tests shows that the actual cost per pound of metal handled will compare very favorably with any other form of fuel. When the electric furnace is able to handle at least 170 heats in ten hours of No. 22 gage steel against 130 heats of the same material by the coal furnace, and with 25 per cent greater weight per charge, the comparison in actual cost of fuel assumes a different proportion and value actually in favor of the electric installation.

Electric furnace now being employed in the firing of vitreous enamelware and resulting in a better product at a lower production cost

The oven in which we are interested is the first commercial installation of such an equipment in the United States, and has been installed within the past six months in a St. Louis factory. The record established thus far has fully justified the engineer in the adoption of this method of furnace heating.

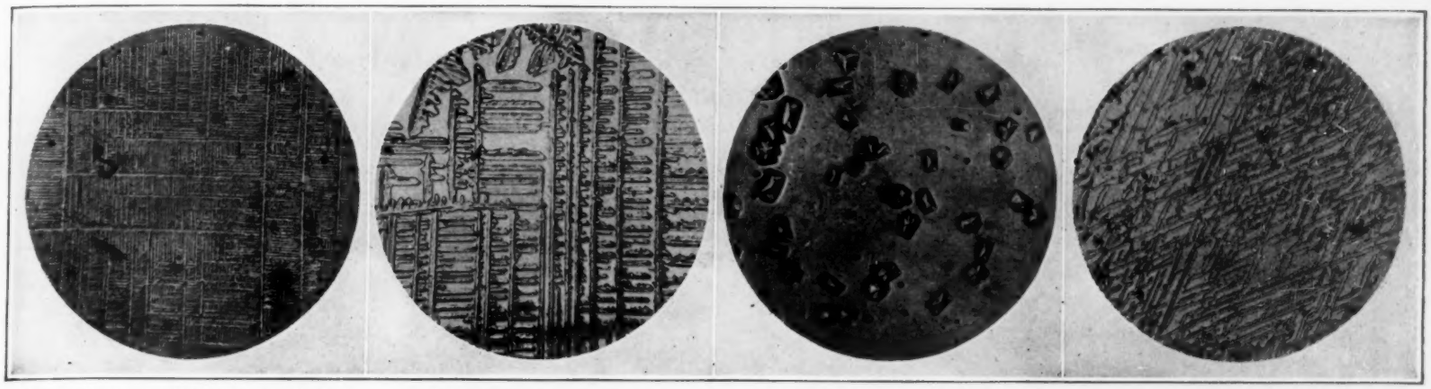
The furnace is located in one corner of the enameling shop, and the power supply is the transformer substation located in an out-of-the-way place on the roof of the building some forty feet away from the furnace. The power is from the same supply that furnishes the power and lighting for the building through an underground 13,200-volt cable from the lines of the local power company.

The furnace measures approximately 12 feet 11 inches in depth by 7 feet 8 inches in width and 7 feet 4 inches in height in overall dimensions. The actual enameling space is 4 feet wide by 2 feet high by 10 feet deep. The roof is curved somewhat so that the actual height is 30 inches in the center and 26 inches at the sides. The heat is obtained from ribbon nichrome wire woven up and down on each side of the furnace over special hanger brick in a lattice-like arrangement. The winding on the lower sides is double while that on the upper sides is single except for about 22 inches back of the door, where a double winding is installed to make proper allowance for the escape of heat when the door is opened and closed for loading and unloading. The nichrome wire is approximately ⅝ of an inch wide and .05 inch thick. There are six heating elements in the furnace and micrometer tests made after sixty days' operation showed no physical change in the windings. Similar nichrome elements for heating, etc., have been in use for over three years without apparent change.

The furnace brick work is built up in the following fashion: There is first a four-inch course of common firebrick and the special hanger brick for the support of the heating elements are incorporated as a single row in this course. Outside the firebrick there is a 9-inch course of insulating brick and then a 4-inch course of common red brick. It is proposed to cover the entire furnace with a coat of asbestos from two to four inches thick. The door is about 4½ feet wide by 3 feet high and is made of insulation brick and steel frame. Usually special monel metal racks are used in carrying the heating work to reduce the area and weight of metal and prolong the life of the racks.

The electrical equipment for the furnace consists of the ribbon windings which have a maximum rating of 150 kilowatts or roughly 200 h.p., and are operated on 230-volt, 3-phase, 50-cycle current. Adequate protection for them is provided by special fuses. Control and record of temperature is obtained by two thermo-couples connected through the walls of the furnace, one of them measuring the temperature of the winding and the other the temperature of the air in the furnace. In addition there is an automatic electric control panel installed at one side to the rear of the furnace containing contactors and automatic switches providing for automatic control of the furnace, and one electrically-operated automatic temperature recorder and control apparatus. The latter gives a recording chart showing the temperatures of both the ribbon and the air and permits of variation in the control of the furnace so that it can be operated at any temperature up to 1800 deg. Fahr., for which it is set. The nichrome windings in the furnace are connected to the control apparatus and to the transformer substation by heavy copper wire installed in conduit, and the entire oven installation is on a separate oil switch which gives it individual control from the lighting and power load of the factory.

The results thus far obtained have been highly satisfactory, particularly with regard to the quality of the output and the speed with which the oven can be brought to temperature. The electric furnace can be brought from stone cold condition to 1700 deg. Fahr. in 12 hours. For similar heating of a coal furnace it would take up to 48 hours, for an oil or gas furnace about 24 hours. The electric furnace has been cut out at 5 a.m. with temperature at 1700 deg. and cut in again at 6 p.m. at 1200 deg. and in forty minutes it has been ready for work at 1600 deg. The production obtainable during an hour is 2338 pounds of ware and racks with the use of 130 kilowatts per hour, the number of charges being 24. This means 900 pounds of enamel were at a cost of $2 for the electric energy used for the furnace.



Chrome alum; perpendicular lines the dominating effect

Lead nitrate shows a lattice pattern

Octahedral crystals of bismuth nitrate

Potassium nitrate gives inclined axes

The various patterns in which some familiar substances crystallize

Natural Designs Artificially Produced

THERE is nothing dry and uninteresting in nature every thing in the animate and in the inanimate world should tend to awake our loving observation. The stones in the interior of our earth should receive as much of our time as the flowers in the fields, the glittering crystals, the gayly colored butterflies, or the mysterious denizens of the deep.

But since the organic things are much more in evidence, and since their beauty is often very striking so that they are seen at considerable distances, the inanimate objects receive far too little attention. But the regular form and cleanliness of the mass are here far more prominent than in the organic world. Every thing is pure about the crystal. All foreign materials have been rejected by it. All similar particles have joined together to produce a harmonic whole, mathematical in its regularity, and wherever the same substances may be found they will always be bound together in the same way. Such is the law of crystalization.

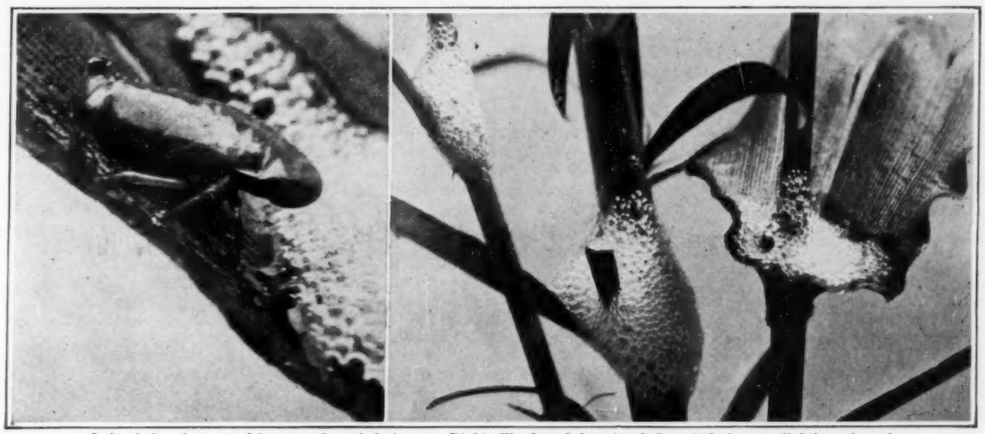
It is indeed a wonderful law which reigns supreme over this dead material. It demands that all chemically pure substances not only have all their constituents, but that they assume a definite shape as soon as they make their appearance in the solid state. One is almost tempted to say that the ideal basic form of nature is developed by the crystal, especially those which were enabled to grow independently and without distortion. But the majority of minerals consist of a mixture of various substances and these do not possess any regularity of form.

The greater part of the crystals are gradually deposited from solution either on cooling or on evaporation of some solvent. The slower this process, the more perfect will be the final product.

All crystalizable substances have the characteristic of growing in all directions of their faces if the substance is continually and evenly deposited on them. The rate of growth, in the various directions, is not uniform, and this gives them their definite shape which is always constant, no matter where or under what conditions they may have formed. This distinct shape can usually be noticed under the microscope at inception. When deposition begins in one direction the crystals never form uniformly, they are distorted.

Imperfect crystalization is by no means uncommon. This is produced through a too rapid deposition, that is, a too rapid growth of the crystal. Then crystalization takes place in one direction with excessive speed. In this way barred, crossed, or star-shaped crystals are

(*Continued on page 212*)



Left: Aphrophora quadrinotata, the spittle insect. *Right:* The larval deposit of the spittle insect, slightly enlarged

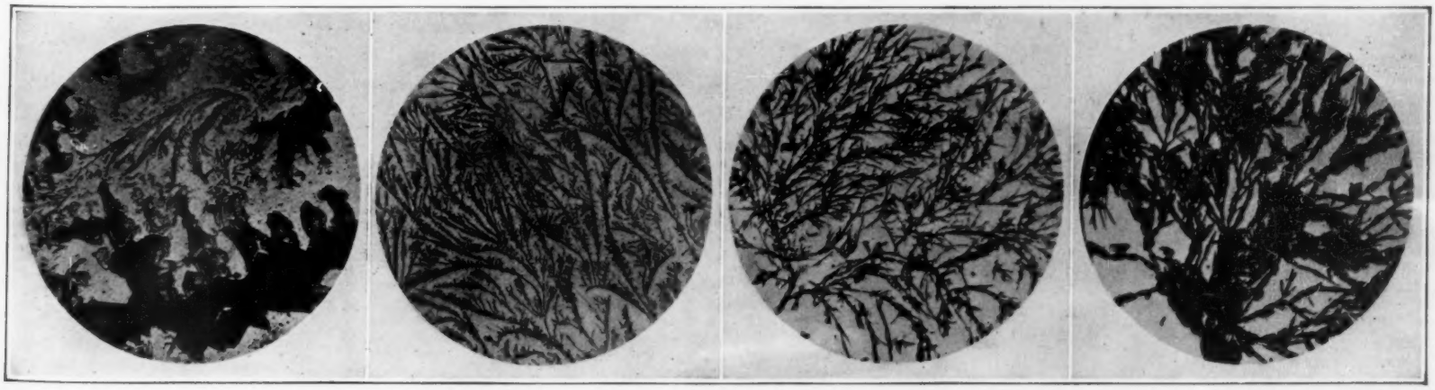
Explaining a familiar mystery of the wet meadows

The Spittle Insect

IN the fields and meadows, while seeking the solitude of nature during the summer months, white foamy masses are often seen on the grasses. This is often called "frog-spittle." But neither man nor animal has expectorated this foamy ball upon the plant. It is the work of a larva from the frog-hopper or spittle insect which lives under this mass of bubbles and withdraws plant sap with its beak from the grass upon which it sits, we learn from careful observation.

The larva remains hidden in the frothy mass, and it can only be seen when this is spread out. The tiny mite which is then uncovered is soft-bodied and pale green in color. In the fall the female of this species lays its eggs on the stems of the grasses, and next spring, when the eggs have hatched and the larva has made its appearance, it migrates to some soft shoot, bores its beak into the tissues, and begins to suck the sap. The white foam begins to form about the animal. The larva takes from the sap all necessary food material required for its bodily growth, and gives off the almost clear unused sap. In this state no bubbles are to be seen. They are formed through the continual expansion and contraction of the abdomen which brings the air into the fluid mass. It seems very probable that the abdomen, during this process, is also used for breathing. In this mass the larva lives until the last molt.

This froth cannot be considered a protective medium from enemies since wasps and other insect robbers know full well what to find in the foamy coating, and they seek it diligently as a dainty morsel.



Potassium ferricyanide; massive crystals with delicate floral designs between them

Mercuric chloride develops shoots somewhat resembling ice flowers

Potassium bichromate gives the suggestion of seaweed

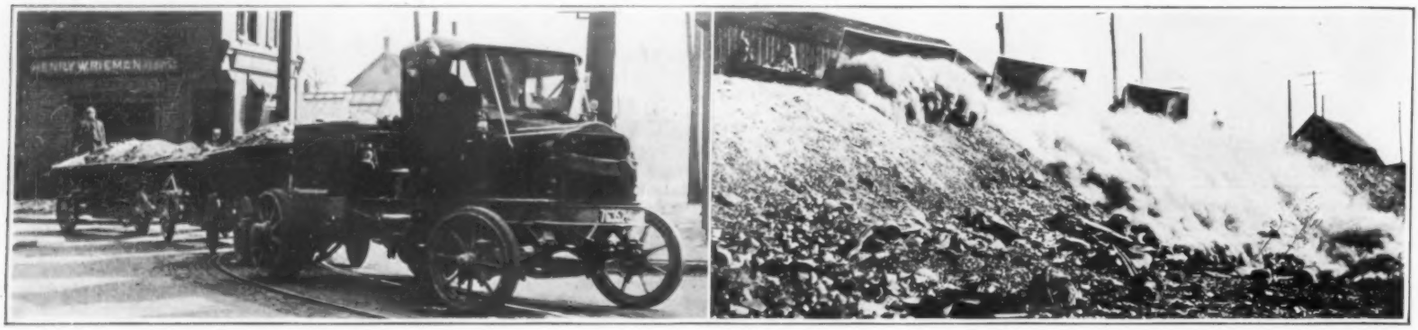
Ammonium bichromate has the seaweed effect but is more massive

Other salts abandon the straight line and give elaborate floral effects

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGÉ, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles



Left: **Motor truck making a corner with a trailer train loaded with ashes.** ***Right:*** **Train load of ashes being dumped at the municipal dump, City of Indianapolis**

Front-Wheel Brakes for Trucks

THE element of speed in motor transportation entails a grave responsibility on the engineer in insuring the safety of the driver, of his vehicle and load and of the pedestrian. In this connection the factor of stopping efficiency is of paramount importance.

Braking efficiency may be easily confused with stopping efficiency. As developed by a leading authority on brakes, the brake which has the capacity to lock the truck wheels is wonderfully efficient in braking capacity, but braking performance of this character is prone to prove disastrous when applied to the road wheels of an automotive vehicle where stopping efficiency is the prime consideration. It has been a simple matter for rear axle makers to design a brake of such character as to avail itself of all stopping capacity afforded by the road contact of the rear wheels, but once this point is passed the dangerous rear wheel skid is induced.

The securing of further stopping efficiency, therefore, is only to be obtained through additional road contact and this in turn is only afforded through the front wheels of the vehicle. Designers of railway equipment soon discovered this point and now we find a brake shoe on each car wheel.

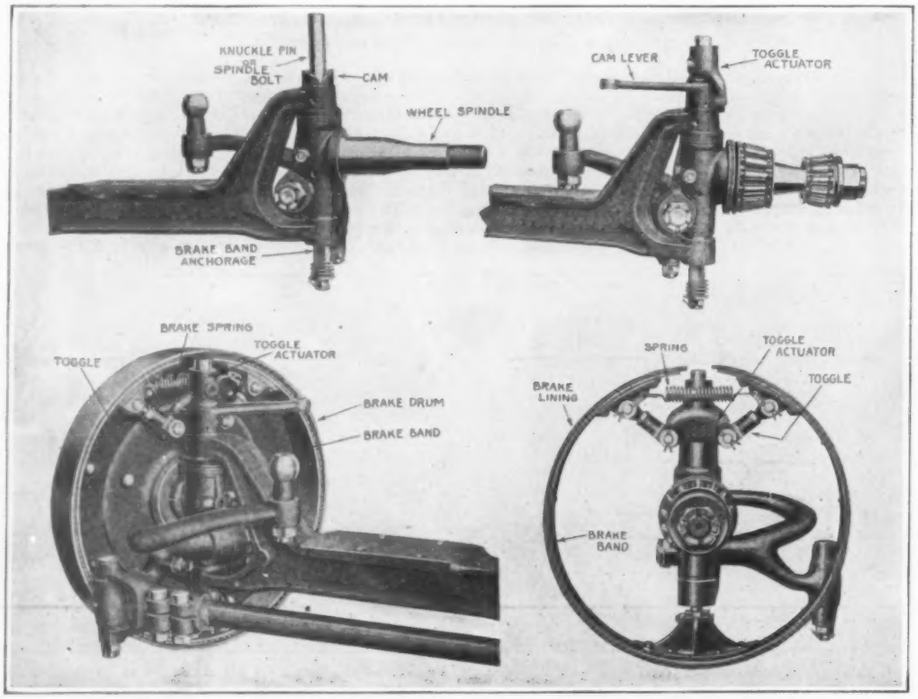
Front wheel brakes are not an experiment. They have been in use on numerous European cars for years and their complete efficiency has been thoroughly demonstrated. The chief obstacle in the way of their general adoption has been the complication presented in their design in applying them to the front axle when the road wheels must oscillate from the axis of the axle in the steering of this vehicle. A casual study of the elements embodied in the design of the front wheel brake as applied to the Shuler line of front axles will serve to convince that the design affords a wonderful simplicity, insuring both the efficiency and economy so essential.

Assuming that brakes are attached to all four wheels of the car or truck and that the braking capacity at each wheel is equal, a simple computation will show that the application of braking effort on all four wheels simultaneously will stop the vehicle in half the distance as will brakes applied to but the two rear or two front wheels independently.

The illustrations herewith shows the simplicity of construction of this front wheel brake and the mechanism by which the brake is operated. The brake lever has a spiral cam surface in its face, the exact reverse to that in the upper bushing supporting the knuckle pin. The cam lever rotates freely about the knuckle pin and is mounted above the cam lever in such a position so that it can be raised by it. The operating sleeve is free to slide up and down length-wise of the knuckle pin, but is keyed to the pin in such a manner as to force it to rotate with the pin around the axis.

A pull of the cam lever causes it to rise upwards on the knuckle pin through the action of the cam and forces the operating sleeve in the same direction, raising the toggles and spreading the band. The cam lever, which is free from any other influence than the cam surface remains constant with the axis of the axle proper, whereas the operating sleeve slides on the back portion of the cam lever to any position impelled by the turning of the knuckle and wheel in the usual steering operation.

As the actuating mechanism is raised, the toggle lever expands the brake band and retards the brake drum motion in the customary way. There can be no interference between the braking and steering action and adjustment to compensate for wear is obtained by altering the length of the toggle arm, which may be done with little trouble by the average automobile mechanic.



Details of the front-wheel brake and how it is applied to the usual motor truck

Ash Hauling Cost Reduced

ON a certain date the contract for hauling Indianapolis ashes expired. The contract had been held by an Indianapolis contractor who submitted a new bid. Beginning the new year it would be worth $84,000 a year and $54 an acre for annexed territory to continue the ash-hauling work for a period of five years. That was the straw that broke the camel's back. The city immediately cast about for a new beast of burden. The result was the purchase of four 5-ton trucks and 25 trailers. This fleet went to work immediately. That was in the winter. Since that time, the motor equipment has gone faithfully along, writing itself off the books. During 1919 a total of 115,286 cubic yards of material was collected and hauled to the dumps. Figuring seven years as the life of the trucks and trailers, the item of depreciation for one year is approximately $8286. Operating costs (including oil, gasoline, tires, repair parts, labor on trucks and trailers) totaled $12,305. Allowance of 6 per cent interest on the balance of the cost of the equipment adds $2784 to the year's total. Then throwing in a payroll of $53,063 the total cost for 1919 amounts to $76,439 which, on the basis of 115,286 cubic yards of ashes collected, gives approximately 66⅓ cents as the haulage cost per cubic yard.

But the real advantage of the motorized and city-controlled ash-hauling system is not at once apparent in these figures. Recall that the renewal term proffered by the private contractors was not a flat figure of $84,000 but rather that amount plus $54 an acre for annexed territory. Since taking over its own ash-hauling job, the City of Indianapolis has extended its service facilities to a greatly enlarged territory which, had it been annexed under the terms of the tentative new private contract, would have run the expense of that service very close to $100,000.

The Indianapolis method of ash collection is as follows: Horses, hauling trailers, wend through given alley routes collecting ashes from house to house. The loaded trailers are then left at predetermined street locations, where empty trailers are waiting. The horses are hitched to the empties and lose no time getting out in quest of new loads. Meanwhile motor truck tractors en route to the ash dumps couple the loaded trailers to the trains and continue on their respective ways.

A New Profession

(*Continued from page 196*)

this connection come up for rather extensive treatment in our general course in landscape gardening." In 1918 the Forest Service published two inspiring bulletins by Professor Waugh, as collaborator: "Recreation Uses on the National Forests" and "Landscape Engineering in the National Forests." He has also outlined a plan for the development of a village at Grand Cañon, Ariz.

A synopsis of principles involved may be gleaned from Professor Waugh's much detailed statements. Three closely related objectives of the landscape engineer are: To preserve the native landscape in its pristine beauty; to make it physically accessible to the largest number of persons; and to present its beauties in the most logical, intelligible and convincing manner. A principal enemy of the landscape is fire, hence the opening of trails for its fighting is most vital. Three specific fields of the work in the profession are: The lay-out of special-permit areas for summer colonies; the location of trails; and the location and betterment of ranger stations and their grounds.

Summer-camp areas are in great demand. In the National Forests sites for cottages may be leased for a long period for a small sum. Considerable colonies of these homes, to which the builders return with their families each season, require a well thought-out plan in advance, otherwise the first comers fill up the choicest sites bordering a mountain stream, running through a narrow valley, or encircling completely the shore of a lake, often cutting off access to the water front or to desirable future trails leading to colony sites to be later developed. The perimeter of a lake, for 50 to 500 feet inland, should be kept open for the common use of all and access allowed at intervals between building lots. Where suitable building spots, as in more open country, are many, home sites may run up to the maximum of 5 acres per family. One acre, represented by a plot 200 by 200 feet, or 150 by 267 feet, is a good average. Four houses to an acre should be the limit of crowding. It is better to open new avenues and establish other centers of community convenience farther on than to permit over-large or congested summer colonies. The checkerboard arrangement of uniform lots is undesirable from an esthetic point of view, though an irregular division requires skill. Each lot should contain a spot level enough for a building. The entire hinterland will be at the disposition of the cottagers for their pleasure, outside of the area reserved for their private use. Proper sites should be reserved and provision made for such utilities as boat landings, store, post office, ranger station, water supply and sanitation.

Trail location is complex. A short and direct route serves expediency, and trails must be suitable for timber cutting and fire fighting, as well as to accommodate tourists; the selection of low grades facilitates climbing and promotes safety; the limitations of funds calls for courses having the least excavating, filling and bridging; yet the landscape engineer's problem is further complicated, for he considers beauty values. Without neglecting utility he must connect scenic points and have them appear, where possible, from points where a major change of direction or grade mark the divisions of a trail into what some clever person has called "paragraphs." Sometimes timber must be cut to open up a hidden sight, leaving other trees to frame the picture; at view points the road should be widened for parking vehicles and benches set for pedestrians to rest; signboards should point to the view and name it, or give facts about it. A near-by beauty spot appears to best advantage as seen from an up-grade; while a distant outlook is at its best from the top of a grade.

(*Continued on page 209*)

Addition of Stiffening Rod Improves Starrett 48″ Micrometer Caliper Gage

The well-known Starrett line of No. 24 Micrometer Caliper Gages has recently been supplemented by the addition of a new model, No. 24-A, which is similar to the 48-inch size of No. 24 excepting that to No. 24-A has been added a stiffening rod reinforcing the entire length of the beam, and also has jaws 4 inches deep in place of the 2-inch jaws with which the No. 24 gages are furnished in the 12, 18, 24 and 36-inch as well as 48-inch sizes. The beams are graduated in 8ths, 16ths, 32nds and 64ths. The head or jaws carry auxiliary tram points and may be removed so that the beam may be used separately as a rule. Attachments are also made to slip on and off the ends of the caliper so they may be used to set inside or outside calipers for making close or drive fits, etc. The inside calipers are set against the inside face of gage and, resting on the seat of the attachments, keep them in perfect line. The outside calipers are set against an extended seat of the attachment in line with the inside faces of the gage so that both inside and outside calipers may be set to agree with each other. This gage may not only be set by the graduated beam but varied by the micrometer adjusting nut to read in thousandths. The beam and attachments, like the jaws, are hardened and ground, insuring long service.

Starrett Micrometer Caliper Gages No. 24 and No. 24-A afford greater scope than any other tool of their kind made, and are widely used in many industries for the accurate measurement of relatively large dimensions. The construction and application of these gages are clearly illustrated on page 106 of the new Starrett Catalog No. 22.

Starrett Tool Makers' Buttons Now Available in 1-Inch Size

From the many machinists and tool makers who have found Starrett .300-inch, .400-inch and .500-inch tool makers' "buttons" a time-saving convenience—especially on jig and die work—has come a strong demand for these buttons in a 1-inch size. In response to this demand, The L. S. Starrett Company now offers Starrett Toolmakers' Buttons, Set No. 494-D, hardened, ground and lapped square with the end to the 1-inch size. A full description of these buttons, with illustrations, is given on pages 116 and 117 of the new Starrett Catalog No. 22. Published by The L. S. Starrett Co., Athol, Mass.

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

CONTROL.—W. G. LANDON, 91 Hope St., Stamford, Conn. This invention relates to a control which is equally applicable to "lighter" and "heavier-than-air" machines, and in the latter case may be applied to any desired type of plane. The device includes a duplicate set of controls, each set comprising a rudder, elevators and ailerons, operated by two independent joy-sticks in the fuselage and means extending between the joy-sticks for detachably connecting and synchronizing the movement thereof.

Pertaining to Apparel

GARMENT FASTENER.—F. D. LAVALLE, 2529 Cambrilling Ave., Bronx, N. Y. The invention relates to separable fasteners for garments, especially designed for use on ladies' underskirts. Among the objects is to provide a simple device which is readily and quickly operable to effect the fastening or unfastening of a garment or other article to which it is applied.

WEARING APPAREL.—A. BLATTNER, 708 Penn Ave., Pittsburgh, Pa. The object of this invention is to provide means in connection with dress shirts for holding the tails of the shirt down in proper position, and for holding the entire shirt in settled position on the body. A further object is to prevent bulging of the shirt at the waist line, especially with trousers worn without suspenders.

DIVERS' SANDAL.—W. C. ZESS, Bethesda, Md. More particularly the invention relates to divers' footgear in the form of a weighted sandal to be worn over a gum or similar boot so that during periods between diving, the diver may slip off the sandals and walk in the boots without undue wear of the foot portion of his suit and without the necessity of having slippers for this purpose.

SHIRT.—H. H. REINEQUE, c/o First Natl. Bank, Los Angeles, Calif. An object of this invention is to provide an article of the character specified having interchangeable cuffs and interchangeable front plait, arranged to be connected to the shirt body or disconnected, so that these parts which become soiled most readily may be removed and replaced by clean parts.

GARMENT.—A. F. SECREST, 1536 N. Topeka Ave., Wichita, Kans. The invention particularly relates to garments of the overall type. An object is to provide a garment which will freely, easily and automatically adjust itself to all movements of the body and which will relieve of any strain or pull the shoulders or other parts not well adapted to bear the same and evenly distribute any such pull or strain over parts best adapted to bear the same.

GARMENT FASTENER.—E. J. F. WEIG, 85 Post Ave., New York, N. Y. This invention relates to a device for fastening a turned-up collar of an overcoat to maintain it tightly closed, the device is also adapted to be used about the sleeves at the cuffs or for tightening trouser legs. More particularly the invention relates to a device in which a strip of material, usually elastic, is employed provided with pointed hooks for pentrating the garment.

Electrical Devices

ELECTRICAL CONNECTOR. — L. VAN ATTEN, 170 Spring St., Ossining, N. Y. An object of this invention is to provide a connector which can be securely locked so as to prevent possibility of accidental disconnection due to vibration or other causes. The connection is especially designed for use in restricted areas, such as the inside of motor cases and such places as have restricted free length of cable or wire.

ELECTRICAL FIXTURE.—F. L. BUTLER, 740 E. 36th St., Chicago, Ill. An object of the invention is to provide an electrical fixture in which means is provided for insulating electrical conducting means from the parts maintaining such electrical conducting means in position. A further object is to provide a device that is ornamental in appearance, durable in construction and thoroughly practical commercially.

Of General Interest

CABINET.—G. POLL, 1918 Harmon St., Brooklyn, N. Y. This invention relates to a cabinet which shall be strong and durable yet not cumbersome in construction. The cabinet is especially adapted for use by oculists, and is constructed to receive a tray for receiving the numerous lenses utilized for eye testing, the entire tray being readily removable for the purpose of cleansing, etc.

SOLID NON-HYGROSCOPIC IRON SALT AND THE PREPARATION THEREOF.—O. ROHM, Darmstadt, Germany. The invention relates to a process for the production of non-hygroscopic iron salt especially suitable for tanning purposes, comprising concentrating the water solutions, which contain iron, chlorin and sulfuric acid in the proportions by weight corresponding to the formula $Fe\ SO_4\ Cl$, under reduced air pressure until a water content of 37 per cent is reached.

CROCHET COTTON OR WOOL HOLDING DEVICE.—W. H. CROWELL, 373 Pacific Ave., Detroit, Mich. Among the objects of this invention is to provide a convenient means for supporting the ball of wool or cotton so that

A PERSPECTIVE VIEW OF THE INVENTION

it is kept clean and can be drawn from the ball or roll as used. A further object is to provide a device which is light and can be supported on the wrist of the user and is made with a handle in which the crochet hooks can be stored when not in use.

CLOSING GUIDE FOR COLLAPSIBLE TUBES.—G. H. NEIDLINGER, c/o Peerless Tube Co., Bloomfield, N. J. The invention relates to means for indicating the relative position of the closing machine with the printing on the collapsible tube in order that the closing machine may be applied parallel to the bottom end of the tube, and to cause the folded end to assume a folded position perpendicular to the axes of the tube.

PIN TICKET.—J. R. BAYER, 1764 Amsterdam Ave., New York, N. Y. An object of the invention is to provide a pin ticket folding fastener which is composed of a single piece of wire and which may be operated to puncture goods and secure the ticket in place or may be positioned over the edge of the cloth or other article without scratching or marring the cloth or other articles.

WATERPROOFING COMPOSITION. — T. BOSSHARD, 385 Cornelius St., Brooklyn, N. Y. The object of the invention is to provide a method of treating bags or woven material such as are used to cover food or confectionery, in such manner as to make the material moisture proof. The composition includes gelatin, water and glycerin in proportions of one-half pound gelatin, eighteen ounces of water and nine ounces of glycerin.

DISPENSING FAUCET.—A. B. GREEN, 161 7th St., San Francisco, Cal. The principal object of the invention is to provide a root beer dispensing faucet which through various passages and combinations of said passages will allow the component parts of root beer to pass through the faucet singly or in combinations. A further object is to provide means by which certain combinations are passed through the faucet in a fine stream while others are passed without any pressure.

Hardware and Tools

LATCH.—L. W. HOLLAND, Pleasant Hill, Mo. The invention has for its object to obviate the necessity of slamming a door in order to insure its latching. In overcoming this use is made of a slidable latching dog which projects normally in such a position that it may be engaged by the latching lug so that the weight of the dog alone is raised prior to the engagement of the latch to hold the door closed.

PIVOT SPRING HINGE.—O. KATZENBERGER, 230 W. Superior St., Chicago, Ill. The object of the invention is to provide a spring hinge which may be used for double swinging doors without injuring the door or the support and with assurance that the door will act in the manner desired. A further object is to provide a spring hinge which does not require expertness in mounting, and spring driving mechanism which is adjustable.

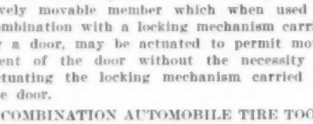
COMBINATION PADLOCK.—W. S. MCADOO, 4114 W. 21st St., Chicago, Ill. An object is to provide a padlock having a shackle which is held positively by a removable pin and which is provided with character bearing wheels or rings that are countersunk, so as to prevent injury to the wheels by a blow from a hammer or the like. A further object is to provide a lock in which there are no projecting parts or openings that permit the use of tools to put the lock out of commission.

CASING SPEAR.—W. J. SHEEHAN, Santa Paula, Cal. The invention relates to tools used in drilling wells and more particularly to fishing tools. One of the principal objects is to increase the scope of usefulness of a casing spear and eliminate a multiplicity of separate and individual tools. Another object is to provide a casing spear with means rendering the same reversible to permit of its use either as a "jar up" or "jar down" spear.

SHADE BRACKET.—W. H. BOOTH, 425 W. 146th St., New York, N. Y. The object of this invention is to provide a bracket capable of application to the side strip of the window sash without any extraneous securing means, such bracket being capable of retaining the ends of a pair of shade rollers in applied position, thus avoiding the necessity of two separate brackets, where shades of two colors are fitted to a window frame.

SPRING SLIDE DOOR JAMB OR LATCH.—F. CLARK, 6 Calle de Juarez 82, Durango, Mexico. One of the objects of the invention is to provide a door jamb or latch having a relatively movable member which when used in combination with a locking mechanism carried by a door, may be actuated to permit movement of the door without the necessity of actuating the locking mechanism carried by the door.

COMBINATION AUTOMOBILE TIRE TOOL.—F. EMMENEGGER, 2644 Chippewa St., St. Louis, Mo. The invention relates more particularly to a combined tire tool adaptable for



A PERSPECTIVE VIEW OF THE TOOL

use in taking off and replacing tires, and is applicable alike to what are known as "straight side" tires in demountable rims, and "clincher" type tires of other rims.

RIVETING TOOL.—A. I. ALBRIGHT and F. L. MYATT, c/o Pope Hardware Co., Monroe, La. The invention particularly relates to rivet holders adapted to hold the made head of a rivet while the other end is being headed. The object is to provide a holder which is especially adapted for use with channel members or the like, as for instance, in the assembling of end cross members and the side members of an automobile chassis.

COMBINATION BARBECUE IRON AND GRATE.—A. H. FROOM, Santa Maria, Cal. This invention is particularly adapted for camp use or where it is desirous of cooking over an open fire. The principal object is to so construct the device that it may be raised or lowered according to the heat of the fire, and that may be manipulated to turn the edibles over so as to present all sides to the action of the heat.

DECK PLATE KEY.—W. MEYER, Genl. Delivery, Tarpon Springs, Fla. The invention relates to a key serving for turning a deck plate by engaging the pins of the key in the pinholes of the deck plate. The general object of the invention is to provide a key in which the members carrying the pins may have relative movement for positioning the pins at different distances to suit the pinholes in deck plates of different sizes.

LOCK.—A. LASKI, Fairfield, Conn. This invention has for its object to provide a cylinder lock for use with mortise locks, for controlling the lock from the opposite side of the door to that upon which the mortise lock is placed, as for instance, in locker doors where the mortise lock is arranged on the inner face, and the auxiliary lock being embedded in the door and operable from outside the door and having means for controlling the mortise lock.

SHEET COUNTER.—E. MORELL, 44 W. 18th St., New York, N. Y. The primary object of the invention is to provide a counting caliper or counting gage, for determining the number of coupons or tickets in a pack, or for determining the number of sheets of material of any class within a single stack, the gage or caliper having indexed means which is readable direct to ascertain the number of sheets placed in the gage.

Heating and Lighting

GRATE BAR AND SUPPORT THEREFOR.—E. B. MCCONNELL, 24 S. 9th St., Newark, N. J. The invention relates to grate bars which are readily interchangeable; an object is to provide a grate bar having high and low trunnions at both ends, and provide supports for the grate bar so that the latter may be supported upon either its high or low trunnions.

GAS BURNER.—E. E. CORNWELL and J. H. MCCREADY, c/o Okmulgee Welding Works, Okmulgee, Okla. This invention more particularly relates to a gas burner for use in oil fields for firing the boilers with low pressure gas and maintaining proper steam pressure for drill work or the like. It is the purpose of the invention to provide a device which will operate effectively and continuously without clogging up or failing to operate.

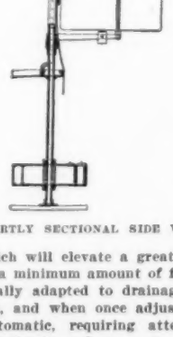
Machines and Mechanical Devices

MATTRESS BEATING AND SHAPING MACHINE.—W. B. KROFF, 1140 Hampshire St., San Francisco, Cal. The main object of this invention is to accomplish by power what is now done by hand. Another object is to provide a power driven beater with means for changing the stroke so as to vary the force of the blow on the mattress in its process of forming and filling, and for turning and sliding the mattress under the beaters.

HYDRAULIC RAM.—J. O. KAFADER, Fort Bidwell, Cal. This invention is more particularly intended for installation in connection with subterranean water stratums at different levels. The general object is to provide a hydraulic ram adapted to be installed in a cased well extending between subterranean stratums that is the upper and lower levels of rise of the water in a well.

APPARATUS FOR BLEACHING, DYEING, ETC.—M. POETZSCH, Overlook Rd., Ridgewood, N. J. An object of the invention is to provide a construction wherein strings or strips of cloth are automatically changed and refolded in a more or less continuous action during the dyeing, bleaching or washing operation so that permanent creases will not be formed in the cloth, and the process will also be shortened.

WATER ELEVATING UNIT.—E. E. SCHUMAKER, Hilbert, Wis. The invention relates to a water elevator including a pump and a driving medium therefor. Among the objects is to provide a wind motor which will function in the most variable and lightest of



A PARTLY SECTIONAL SIDE VIEW

breezes, which will elevate a great amount of water with a minimum amount of force, which will be equally adapted to drainage and irrigation work, and when once adjusted will be entirely automatic, requiring attention only when it is to be stopped.

(*Continued on page 210*)

A New Profession

(*Continued from page 207*)

The two best fields from which to draw illustrations of recreation engineering work already accomplished and planned ahead for that happy time when Congress may provide the wherewithal are the National Parks and the National Forest Service. In the parks it is called landscape engineering and the new department was opened in 1918. The director's reports show the manifold activities of the profession to include: Vista cutting, clearing away trees that are down along roadsides, general elimination of all dead trees, location of roads and bridges, town planning, forestry and the drawing or censorship of plans for all buildings to be constructed in any of the parks, whether by the Government or by public operators of hotels and concessions. As much effort has been expended in advising what not to do as upon what to do.

Items chosen from a long list of actual construction or recommendations for the future are quite assorted. Various camp grounds were arranged for the numerous motor tourists and essential utilities provided. Some present buildings not in keeping with mountain landscapes were altered, as in the covering of an ugly post office with bark. In Yosemite the director spent half a year upon plans for extensive developments of the Park company, which are already under way according to this unified scheme. He also planned the village of Yosemite, allowing commercial, industrial and residential zones. In Mt. Rainier he approved plans for buildings in Paradise Valley. An administrative group was designed for Longmire Springs. In northern California a redwood forest proposed as a future park was inspected. At Grand Cañon the relocation of some buildings and plans for an automobile camp and administrative group were made. In Yellowstone new filling stations attractively made of stone and logs were put in, sketches made for new ranger stations and alteration of some present buildings of public operators recommended. At Rocky Mountain Park the site offered by the village of Estes Park for administration buildings was passed upon, the structures considered and rustic gateways designed for roads entering the park. Standard signs for all parks were designed, of metal, with plain green lettering upon a white ground, and to be affixed to posts instead of to growing trees. Insignia to distinguish the various branches of the service will be worn.

As the widespread use of automobiles and the motor tourist camp were a development not at first anticipated so the probable future use of airplanes is suggested. Provision must be made ultimately for landing places, signs and hangars to accommodate air travel. We may look forward to a time when funds will permit building a community center in each motor camp where tourists could gather under shelter for sociability or to hear lectures, where they could rest, read, write, buy supplies, get mail, use bathing and laundry facilities, or study collections of the flora, fauna and geology of the park visited.

In the National Forests no special financial provision has been made strictly for recreation, though advance work and plans have been started, mostly by men engaged in other aspects of the forest work and with funds saved from other appropriations or provided by public-spirited citizens of the regions most accessible to the use of the improvements. Thus in the national forests of California eight free leaseholds of sites have been given to communities from 25 to 150 miles distant; three to Los Angeles and one, each, to Oakland, Sacramento, Fresno, San Diego and Riverside County. Some of these municipalities have already built and paid for cabins and central cooking and administration and recreation buildings and arranged organized vacations for their citizens and taxpayers. The business men of Sacramento are so pleased with theirs that they are raising a gift of $10,000 with which their city may build cabins. In the eastern forests of the Seventh District, including those in Arkansas, Alabama, Florida, Oklahoma, South Carolina, Georgia, North Carolina, Tennessee, Virginia, West Virginia, New Hampshire, and Maine surveys of recreational possibilities have been made of the Pisgah in North Carolina, the Wichita in Oklahoma, and the White Mountains in New Hampshire and Maine. Areas suitable for camps will be reserved and a start has been made in building fireplaces and sanitary conveniences at places most used by transients, as in the White Mountains.

Mr. Arthur Carhart, employed definitely as the first recreation engineer in the United States Forest Service, concentrates his time upon the Second District, comprising Colorado, Wyoming, Nebraska, South Dakota, Minnesota and Michigan. In the San Isabel, in southern Colorado, 651,000 acres have been planned as a unit. A number of utilities have been already put in in selected areas as shelters, water supply, sanitation, fireplaces, etc. Two organizations of citizens of neighboring towns financed these. In the Pike Forest of Colorado are attractive log shelters. In the Shoshone, of Wyoming, Wapiti Camp is a splendid sample of what can be done for about $1000. A neat log hut, cement floored, has three entirely separate compartments: two bathrooms with running water, modern plumbing and showers, and a smaller alcove just holding a wood stove and water tank. With free fuel at hand the tourist applies his match and cooks a meal while heating his bath water. On the grounds are hydrants, garbage pits, fireplaces, benches and tables. Mr. Carhart thinks the use of the forests of his district alone would justify the building of ten such stations a year for five years.

This summer the planning of the glacier region of the Colorado National Forest will be undertaken and Mr. Carhart has already spent some months in outlining the hoped-for future of the canoeist's last frontier in the Superior National Forest, in far-northern Minnesota, up to the Canadian border. Within a million acres the timber is interrupted by 150,000 acres of lake surface, which determines the character of the proposed development. Without motor roads and railways, water forms the avenues. For easy pleasure a seven-day motor boat trip is outlined taking in six lakes, an Indian village, several waterfalls and rock cliff paintings. For the more hardy vacation seekers canoe trips of three, seven and twenty days have been outlined and proper provision worked out for boat landings, stores, hotels, camps at the end of each day's journey, portage trails laid out, places for pack and canoe rests indicated, and signs designed to lead strangers safely through the wilderness. Each sign would be visible ahead from the last one.

Scattered all over our country are public lands awaiting funds for their fuller recreational development, and dependent upon the creation of public sentiment that will teach the hands of taxpayers to find their purses. Iowa, to take an example, has plans for a comprehensive system of state parks. Its Conservation Commission has already secured several tracts and hopes ultimately to have a park accessible to any resident at a distance of not more than a county from his own home. The American and Scenic Preservation Society, an organization with headquarters in New York City, has already done some valuable work in developing public areas for recreation uses.

Philadelphia's Tear Bombs and Mobs

(*Continued from page 197*)

take the trail in motorcycles with side cars and overtake the fleeing motor car. Shooting from a motorcycle going at a mile a minute is haardous business at

RECENTLY PATENTED INVENTIONS

(Continued from page 208)

Machines and Mechanical Devices

CENTRIFUGAL PUMP.—L. A. MYERS, Box 5, Seabright City, Cal. One of the foremost objects of the invention is to provide a self-balancing runner for centrifugal pumps, the object being obtained by the use of a baffle plate for isolating the impeller disk from the reduced pressure at the pump inlet, thereby, leaving the runner to float freely in the pump case, and relieving end thrust thereon.

SEWING MACHINE.—A. A. BOUTON, c/o Jennings Lore Works Corp., Park Ave. and Hale St., Brooklyn, N. Y. Among the objects of the invention is to provide a sewing machine in which the work is presented to the needle upon a traveling carriage in straight lines without any sidewise wabbling. The invention has particular reference to the carriage construction and its associate parts.

WATER FEED FOR STEAM BOILERS.—W. A. WHITMORE, Nelsonville, Ohio. The prime object of the invention is to provide a receiver to which the feed water is delivered by a supply pipe and so associated with the trap that with each operation of the trap, the water will flow to the boiler from both the trap drum and the receiver, whereby any predetermined amount of water may be fed to the boiler with each operation of the trap.

TIME CONTROL.—J. L. WINKLER, 28 Goss St., Hempstead, N. Y. The invention relates more particularly to a time control for use in connection with the operation of a photograph printing machine, although not necessarily limited to this adaption. An object is the construction of a device which will automatically release the parts and extinguish the source of illumination upon a predetermined amount of time having elapsed.

TURBINE.—L. R. GUTHRIE, Bellflower, Mo. An object of the invention is to provide a turbine embodying but relatively few parts which renders the device of simple and cheap construction. A further object is to provide a turbine rotor having an arrangement of disks having concentric annular corrugations. A still further object is to provide an automatic arrangement of governor for controlling the valves in accordance with the direction of the flow of steam.

APPARATUS FOR RECORDING MOTION AND SOUND.—R. D. GRAY, Midland Park, N. J. The invention relates to apparatus for producing a moving picture film and a sound record in synchronism. The object is to provide an apparatus for recording motion and sound arranged to encompass a number of performers, say actors, players of musical instruments or other sound-producing media, distributed on a stage or other support for producing both a kinetoscopic record and a sound record.

REVERSIBLE FAN.—R. M. MURRAY, Billings, Mont. The purpose of the invention is to provide means controllable by the operator for changing the pitch of the blades, and for reversing the direction of such pitch. By the aid of this device a fan or a propeller can be so manipulated as to produce an infinite number of variations in the volume of air, gas or liquid controlled so that the velocity and volume of the currents may be regulated without changing the speed or rotation.

Medical Devices

FALSE TEETH ATTACHMENT.—B. ELISBERG and W. SHEFF, address B. Elisberg, 1390 Clay Ave., Bronx, N. Y. The invention has particular reference to an attachment adapted to secure false teeth in the mouth of the wearer. It comprises elements hinged to the opposite sides of the plate and means for normally effecting the movement of said elements to cause the same to grip the gums and to prevent the teeth falling when a person coughs or sneezes.

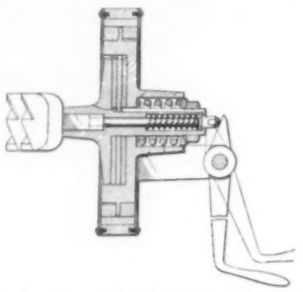
Musical Devices

TUNING SLIDE FOR TRUMPETS AND THE LIKE.—E. B. STEINDORFF, Stillwater, Minn. The invention relates to an adjustable stop by which to determine the position of the slide to produce a note of desired pitch from the instrument. The object is to provide a construction embodying threadedly engaged parts and stop members whose relative movement takes place without danger of impairment of the threads.

SOUND POST.—W. E. LEIGHTON, West Pembroke, Maine. The invention relates to string instruments, and more particularly to violins. The object is to provide a post which may be positioned directly under the bridge and by means of which the amplitude of the sound waves are given more carrying power, together with a more resonant tone quality. The post may be conveniently utilized in connection with different types of stringed instruments.

Prime Movers and Their Accessories

SAFETY CRANK.—C. GREEN, Cornwall Landing, N. Y. The invention has for its object to provide a safety crank particularly adapted for use in turning an internal combustion engine over for starting the same, but



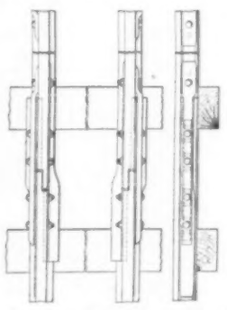
SECTIONAL SIDE VIEW OF THE INVENTION

which is not necessarily limited to this adaptation, and by means of which, upon a back fire occurring, a retrograde movement will result through an arc of such smallness as to be well-nigh imperceptible so that no injury to the operator may result.

VULCANIZER.—W. R. YOUNGER, Alexandria, La. This invention has for its object to provide a device of the character specified, which may be attached to the exhaust pipe of an internal combustion engine, as for instance, that of a motor vehicle to support the vulcanizer in position for use, and to heat the vulcanizer by the heat of the exhaust gases.

Railways and Their Accessories

RAIL JOINT. — G. J. MURPHY, Baradero, F.C.C.A., Buenos Aires, Argentina. The general object of the invention is to provide joint elements to insure the free expansion and



A PLAN AND SIDE VIEW OF THE JOINT

contraction of the rails under changes of temperature, and the maintaining automatically of the joint bolts at right angles to the rails without straining the bolts, and to prevent jars or shocks as the car passes over the joint.

DOOR OPERATING MECHANISM.—J. M. POMBO, 58 W. 91st St., New York, N. Y. An object of the invention is to produce a power-operating door mechanism for railroad cars, coaches, street cars, and subway trains where it is essentially necessary to handle crowds and fill and empty coaches as fast as possible. Another object is to provide a door operating mechanism which may be operated by one man, such as the motorman or engineer.

best. If a hit is made it is mere accident. Then, too, the police take all the risk of collision. Not long since a gang of youths too, the police take all the risk of collision. Not long since a gang of youths was arrested in Philadelphia for automobile stealing and the leader, a seventeen-year-old, boasted of the tricks used by motor car thieves to escape the police. He explained that a series of left-hand turns at forty miles an hour will invariably distance the fastest motorcycle if it is carrying a side car, as is usually the case. Even without the side car, according to this expert, a motorcycle cannot turn with safety at as high speed as an automobile, so that escape is only a matter of continual turning.

Some months ago a Trenton motorcycle policeman was shot and killed by a boy automobile thief fleeing from that city. He had overtaken the car and rode alongside, or within a few lengths, for nearly a mile before he was struck with the fatal bullet. It is contended that had he been equipped with a tear bomb his life would have been saved, in all probability, as he had plenty of opportunity to throw it into the car. Another advantage of the bomb for this kind of work is that it makes a stain on motor varnish by which the car may be recognized by police elsewhere, if the driver escapes his first pursuers.

"These bombs will not be used against every crowd that creates trouble," says Superintendent Mills. "They are for use only against mobs bent on destruction; mobs that assume dangerous proportions and that cannot be dispersed by ordinary methods. A bomb squad is being formed for each police division, and these men will be trained in the use of the new weapons. Only men who can keep their heads in emergencies will be appointed to these squads."

Copper-Fouling of Ordnance Materials

(Continued from page 197)

of sheets, bridges, tanks, piping, etc., are concerned.

Without giving a detailed description I merely recall that the metal to be applied, that is to say, in the present case the tin-lead alloy, is introduced in the form of 1 mm. to 2½ mm. diameter wires in the central part of a blow-pipe nozzle (oxyhydrogen or oxy-acetylenic blow pipes). This thin wire is drawn longitudinally through the nozzle by means of a turbine actuated by compressed air. When the blow-pipe is properly adjusted the melted metal is transformed, as it comes out of the nozzle, owing to the momentaneous depression that occurs at that very place, into comparatively low-temperature particles which are expelled with extreme violence by the blast of air.

These particles stick to the surface to be covered, which can, in this manner, receive a thick or thin coating as desired. In order that such coating may firmly adhere to the surface on which it is projected it is most indispensable that this surface should be properly cleaned by means of the sand blast.

The Schoop metal spraying pistol is recommended on account of its facility of working. Its dimensions are 15 x 15 x 10 mm. and it weighs 1½ kilos (a little over 3 lbs.); it enables projecting about 8 kg. (16 lbs.) of tin-lead alloy per hour. Now, the quantity of metal required for each shell is very small as shown by the following table:

75 mm. gun	6 to 8 gr.
155 mm. gun	25 to 30 gr.
320 mm. gun	80 to 100 gr.

Therefore, shells can be coated in a very short time. Besides, the coatings obtained in application of this Schoop process adhere most firmly to the surface and never detach themselves from the shells during their handling and transportation.

The brief statement given above illustrates the usefulness of this invention. "The use of this process," writes Colonel Mercier, Inspector General of the heavy Artillery material and training, "provided an immediate solution to a situation that became most serious. Moreover, it brought back to life guns of the largest calibers, that were considered as definitely out of use after 500 shots, while they have exceeded 1000 shots and still give an accurate firing." And in another note he again says "that as far as facility of adoption is concerned this process is not to be compared to any other since it is most reliable while being hardly noticeable."

A Problem in Levels

(Continued from page 198)

when it was found that the water level had been lowered only 3 inches. But this meant that the one skip was able to offset the inflow and do a little unwatering in addition. The second skip was now installed, the work being done in 8 hours this time. By the following day the two skips had reduced the level about 2 feet. The pump room was now accessible from the air shaft, and the skips were kept at work intermittently until the pump could be started up again. The skips were, in fact, able to keep the water from rising again by being worked one-half or one-third of the time. With a single skip at work a trip could be made in 75 seconds. But, by an effort, this time could be reduced, it was found, to 60 seconds. When two were working simultaneously, a skip would discharge every 31 to 38 seconds. It took 20 seconds to hoist a skip and its load through 700 feet, and about 14 seconds were consumed in slowing down and dumping. The dumping was done in 5 seconds. Mr. Brackett calculates the capacity of the combination of two skips at 2120 gallons per minute. The coal consumed in making steam for the hoisting engine is estimated at 19 gross tons per day of 24 hours. This estimate relates to the fuel properly charged against the hoisting of the water.

The electrically operated hoists are now entering the field in competition with those operated by steam. Local conditions naturally play a part here. Where electricity is already used by a mine or group of mines, a hoist will likely prove most economical when made a part of the prevailing system. Whether the control is better with electricity I cannot say. If so, this would be a strong point, as loaded skips constitute more or less of a menace in vertical shafts. Thirty-eight thousand pounds free to fall 700 or 800 feet might do some damage.

Group Medicine

(Continued from page 201)

generally done for thirty or forty dollars. There is hardly any question of exploitation of the patient here. Well organized and self-respecting Groups adhere as closely to ethical practice as though each man stood singly.

Probably it is due to the influence of the Mayo Clinic at Rochester, Minn., that so many of the groups already organized are to be found in the West, and it is only recently that the more conservative East has become the center of the advance.

Clinics are now actively operating in Duluth, Minn.; Minneapolis, Minn.; La Crosse, Wis.; Madison, Wis.; San Diego, Cal.; Little Rock, Ark.; South Bend, Ind.; Rockford, Ill.; Cleveland, Ohio; Detroit, Mich.; Lexington, Ky.; Memphis, Tenn.; New York City; Rochester, N. Y.; Buffalo, N. Y.; and Syracuse, N. Y. There are undoubtedly others which are not so well known, but this list will serve to show how widespread the movement has become, and these clinics are only pioneers in a development which promises to supersede the old-fashioned form of medical practice. Group Medicine is one of the outgrowths of our complex life. The same spirit is abroad in other professions and we find the lawyers forming partnerships with regard to criminal and corporation law. The architect now affiliates with the

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constructional engineer, the heating and ventilating engineer, and the excavating engineer.

What more sane than that our bodies should receive the same consideration as our legal well-being or our habitations?

The layman is the person most vitally affected by this new development for the *raison d'être* of medical science is, after all, the patient, and the medical profession keeping abreast of the times must work together in the future more closely than in the past for the ultimate relief of suffering humanity, emphasizing more and more preventive measures by the early detection of disease and thus securing our maintenance in health.

Sir James MacKenzie has recently organized a clinic at St. Andrews to be devoted to the study of the early symptoms of disease. He believes that "before organs begin to break down under stress of disease there is a period of infection or intoxication referable to the whole system but not definitely located. This is the period of early signs and symptoms. The symptoms are present but because they are not yet referable to any system or organ are largely discounted with the result that opportunities which can never recur are missed. Necessarily, the study of this vast and vague field demand tireless energy.

It is believed that eventually a medical examination of our bodies will be as much a routine of the year as is at present an examination of the teeth. Group Medicine is a step in the direction toward taking preventive measures in health as in sickness.

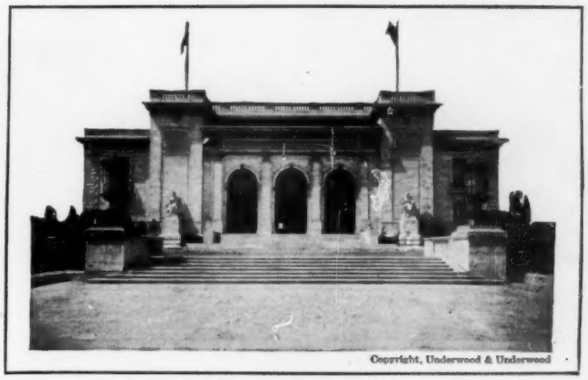
Fish Stories That Are Stranger Than Fiction

(*Continued from page 202*)

petrified article. A box full of them would pass for an assortment of whetstones just like those used by reapers in the fields for sharpening their scythes. One would never suppose that these stone-like objects could be converted into juicy fish-steaks. There are, however, the telltale flesh markings; and a few parings of a penknife from the boxwood-like substance tells you that you are in the presence of a delectable bonito-steak for which the Niponese in America pay two dollars a pound. It is used sparingly, however, by the Orientals, who grate it for use in soups and salads. An American business man would be apt to keep it on his desk as a paperweight and a constant source of mystery to his friends. Each bonito yields four such "steaks." They are sun-dried without a particle of salt, then smoked thoroughly. The result is a stone-like product. It is perhaps the chief fish-product edible curio of the globe.

Another queer marine product from the inland-sea are dried clams. They are sold loose, or are spitted on split bamboo when fresh and thus dried. The so-called "bombai duk"—so much used by Orientals as a curry in rice dishes—is a regular Niponese product. It is rotted fish, "ripened" to the point where the cellular tissue breaks down through decomposition. Then it is sun-dried and put up in cans. The odor is disgustingly penetrating—so much so that one gets a whiff of it even through the supposedly impervious sheet-metal container. In use, the Asiatics take up a little of the light-brown substance and powder it between the fingers over their plates of cooked rice. It leaves a clinging, nauseous odor on the hands.

It is a singular commentary on the many faiths and creeds and notions prevailing amid the uneducated of Manhattan—and many of the educated, for that matter!—that a certain fish-product should be on daily sale here as a supposed cure for rheumatism. This is the eel-skin. It is sold in various sizes. The skin is tied around arm or elbow or wrist or ankle or thigh, or elsewhere near the affected part. And there are those who swear by its effectiveness!



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The Pan-American Building in Washington, Where the Disarmament Conference Will Probably Be Held

Finally, the visitor may see on daily sale in the Mongol stores the hard shark's belly and shark fins. There are also canned rice-field worms (imported as rice "fish"). Their nutritive value is low. And in the Latin quarters only—among the Iberian, Italian and French fish shops—one will find the fresh snails on sale in season alive, creeping all over the shop; while canned, stewed snails and frogs' legs, dried and fresh, are available. Seaweeds as foods are obtainable regularly at Irish and Asiatic stores in large variety.

The Granite Gorge Bridge Across the Colorado

(*Continued from page 203*)

Angel Trail. The packing of the cables down into the Canyon was accomplished on the 11th and 13th of April of the present year, and the two tasks were executed without a mishap. The journey in each case took from eight in the morning until four o'clock in the afternoon—two hours being allowed at midday for rest. It should be borne in mind that the floor timbers, the hanger, and the stirrup rods had likewise to be transported on the backs of pack animals; and all told sometimes more than 40 tons of materials and supplies were thus got down to the river's edge.

The floor system of the bridge is suspended from the main cables by ⅜-inch special steel wire-rope hangers, placed 6 feet apart, which are attached to the floor beams by ⅜-inch steel stirrup rods, spaced at intervals of 3 feet. Each hanger cable is yoked to two stirrup rods. The bridge floor is 5 feet wide with guard rails of heavy-mesh wire; and owing to wind action and vibration it has been found advisable to provide impounding gates at each end of the structure so that only one mule or horse can be taken over at a time. Until accustomed to the journey, the animals are blindfolded.

The main cables were drawn across the Colorado and anchored during the second half of April, and before the month ended the floor boards were in position. The suspension bridge was formally opened to travel on the 17th of May; and the span cost complete substantially $13,000. Two other bridges are contemplated for different points on the Colorado within the National Park area, and they are intended to facilitate still further rim-to-rim travel. It is not hard to imagine the thrills that will be experienced by the uninitiated when first venturing across the bridge astride a blindfolded pack animal, even though the beast may be a sure-footed burro or mule.

Natural Designs Artificially Produced

(*Continued from page 205*)

formed. Others develop into fence-like or netted crystals, while others have certain axis parallel to each other.

But each distinct substance which is crystalizable has a definite crystal shape, and this shape is seldom if ever duplicated in any other substance when examined microscopically. This is due to the internal structure of the molecule, although there may be a few limiting forms possible with the same substance, such as the cube and the octahedron, etc. But both are built of similar particles, and their arrangement, in the final analysis, is the same.

Three separate types of crystalized substances can easily be distinguished upon the slide of the microscope. These are the crystals themselves, the barred or crossed forms which have one axis parallel or nearly so, and those which develop curving or spiral-like shapes like winter flowers on the window pane.

Such forms can be produced from pure salts when dissolved in water and if a drop of this solution is then placed on a glass slide of the microscope. When the water has evaporated, which must not be hastened but progress slowly under ordinary atmospheric conditions, the characteristic shape which this substance will assume under *these* conditions will have been developed. Of course, some of the substances will here develop excessively in one direction at the expense of the others, but this is not true for all salts.

No matter how often the *same* substance may be taken and crystalized out of solution under *these* conditions, the *same* characteristic shapes will *always* be obtained. A drop of the substance is sufficient for microscopic analysis, and a very dilute solution is all that is necessary. The most common solvent is water, and wherever possible it should be used. Alcohol and other very volatile liquids are not very well adapted for this purpose. They seldom produce characteristic crystals since the rate of evaporation is much too rapid.

When a number of substances have been studied under the microscope, they will easily be identified with accuracy when seen again and an entire system for the identification of different salts can soon be developed by this method for those that are interested in this absorbing study.

The growth of the different salts undergoing crystalization can be observed with greater ease and comfort than is possible when watching the development of ice flowers on the window pane. There is something fascinating in watching the sudden twists and turns of freezing waters, and one instinctively speculates on the direction of the next shoot. But it is absolutely unnecessary to wait for winter to come along in order to see just as beautiful and artistic designs which Mother Nature produces during the night with the aid of a little moisture and cold.

Dyes for China

THERE is a big market for both indigo and aniline dyes in China, and, unfortunately, the quantities that are being sent are quite inadequate to meet the demand. American and Continental manufacturers have got a big hold in China, and this is partly due to the British manufacturer's difficulty in getting export licenses. Japanese firms are doing a big business in aniline dyes.

In 1919, the imports of artificial indigo were valued at H.K.Tls.1.31 million, as against Tls.146,642 in the previous year, and those of aniline dyes at Tls.3.04 million, against Tls.752,000 in 1918. This shows a very striking recovery in the trade, but in spite of the great increase in price the figures are still much below the imports in 1913, when the value of aniline dyes and artificial indigo imported into China were Tls.5,401,820 and Tls.9,633,157 respectively.

The consumption of synthetic indigo in China in 1913, the last normal pre-war year, amounted to about 17,000 tons. The much smaller consumption since that is accounted for partly by increased cultivation of natural indigo, and partly by greater economy in the use of the dyestuff.

Against the pre-war price of about Tls. 40.00 per picul, synthetic indigo of the same strength is now selling at Tls.120.00 to Tls.140.00 per picul.

Germany is gradually regaining a foothold with aniline and indigo dyes. Considerable quantities of German aniline dyes, supposed to consist principally of accumulated stocks, have arrived from Dutch ports, and are being eagerly bought up at big prices. Two German firms have their own German representatives in close touch with their old Chinese dealer associates, and one firm is reported to have booked orders to an extent of about Tls.200,000. The strong position held by German dyes in this market prior to the war still stands them in good stead, and as soon as sufficient stocks are available competition will be increasingly difficult. Unless our manufacturers succeed in introducing their own "chops" during the present shortage of German dyes they will have the utmost difficulty in getting a share of this important market.

Have you got acquainted with Kelly Caterpillars yet?

Few truck tires are bought solely on a price basis today. Truck-owners have learned by experience that cheap tires do not mean cheap mileage.

Some truck-owners, however, may have been deterred from trying Caterpillars because of their slightly higher first cost. These lose sight of the fact that Caterpillars are giving the average user far greater mileage than he has ever been able to get from any other type of tire, and that in addition he is getting a combination of resiliency, traction and dependability obtainable in no other tire.

Thousands of truck-users, including the owners of some of the largest fleets in this country, are going over to Caterpillar equipment exclusively because they have found it pays.

If you are not among them, try just one pair of Caterpillars. You'll never go back to any other kind.

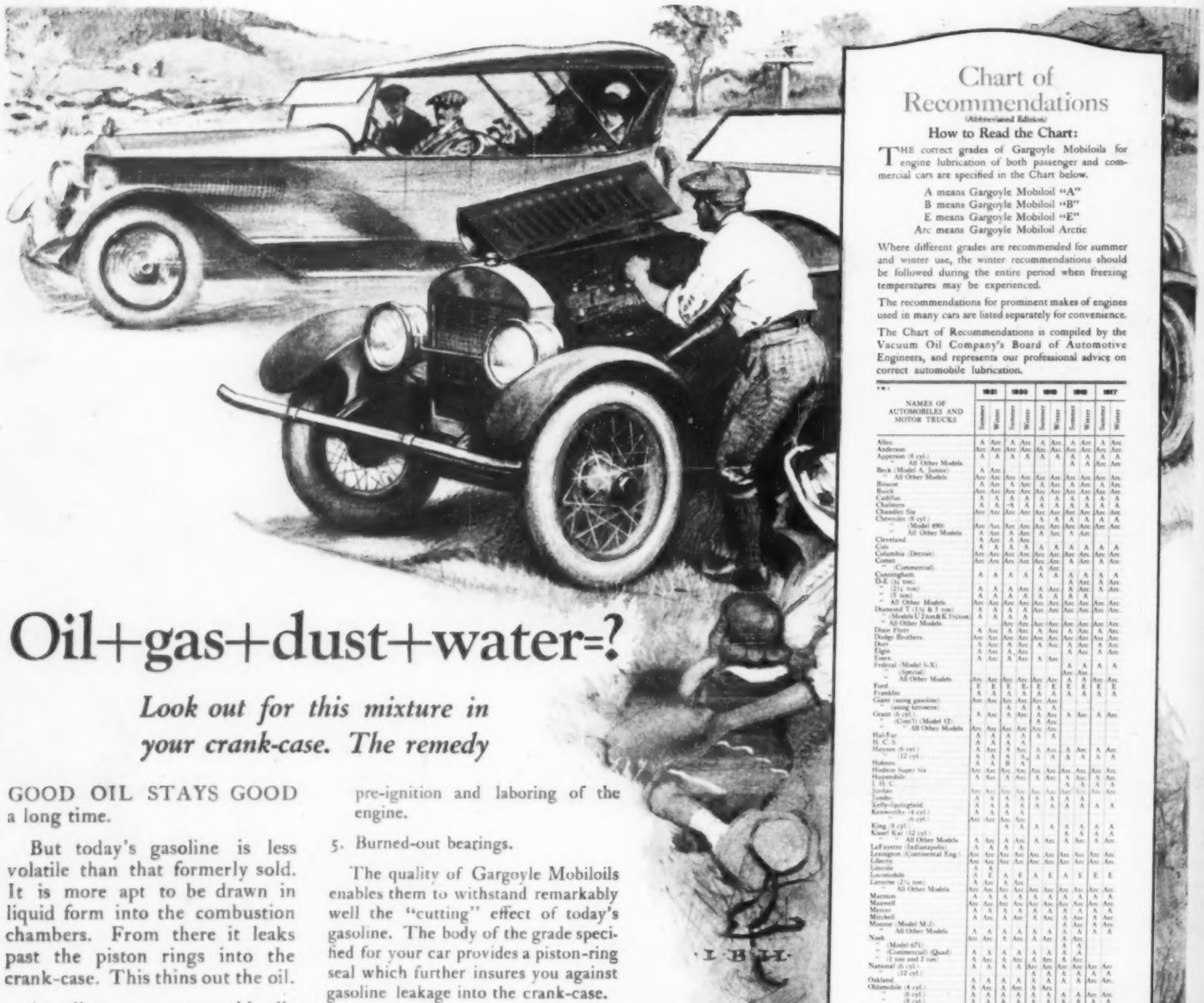
Made in sizes suitable for trucks of every type and weight

KELLY-SPRINGFIELD TIRE CO.

GENERAL SALES DEPARTMENT

1710 Broadway **New York**

Post-hole digger owned by the Pacific Tel. & Tel. Co. of San Francisco. The mechanism was conceived and developed by two employees.



Oil+gas+dust+water=?

Look out for this mixture in your crank-case. The remedy

GOOD OIL STAYS GOOD a long time.

But today's gasoline is less volatile than that formerly sold. It is more apt to be drawn in liquid form into the combustion chambers. From there it leaks past the piston rings into the crank-case. This thins out the oil.

As mileage mounts up, this oil-and-fuel mixture is often further adulterated. Carbon is added. Road dust enters through the carburetor. Water and rust may also be present.

Then what?

1. Premature wear of cylinders, piston rings, crank-shaft, crank-pin and piston-pin bearings.
2. Poor compression.
3. Increased fuel and oil consumption.
4. Excessive carbon deposits, causing pre-ignition and laboring of the engine.
5. Burned-out bearings.

The quality of Gargoyle Mobiloils enables them to withstand remarkably well the "cutting" effect of today's gasoline. The body of the grade specified for your car provides a piston-ring seal which further insures you against gasoline leakage into the crank-case.

But even with this scientific and economical lubrication all used oil should be drawn off at least every 1000 miles and replaced with fresh oil.

It will pay you today to begin to use the right oil—*in the right way.*

If your car is not listed in the partial chart shown here, consult the complete Chart of Recommendations at your dealer's, or send for booklet, "Correct Lubrication," which lists the correct grades of Gargoyle Mobiloils for all automobiles, tractors and motorcycles.

GARGOYLE

Mobiloils

A grade for each type of motor

Domestic Branches:

New York (*Main Office*)	Philadelphia	Detroit	Minneapolis	Des Moines	Boston
Kansas City, Kan.	Pittsburgh	Chicago	Indianapolis	Buffalo	Dallas

VACUUM OIL COMPANY

Chart of Recommendations

(Abbreviated Edition)

How to Read the Chart:

THE correct grades of Gargoyle Mobiloils for engine lubrication of both passenger and commercial cars are specified in the Chart below.

A means Gargoyle Mobiloil "A"
B means Gargoyle Mobiloil "B"
E means Gargoyle Mobiloil "E"
Arc means Gargoyle Mobiloil Arctic

Where different grades are recommended for summer and winter use, the winter recommendations should be followed during the entire period when freezing temperatures may be experienced.

The recommendations for prominent makes of engines used in many cars are listed separately for convenience.

The Chart of Recommendations is compiled by the Vacuum Oil Company's Board of Automotive Engineers, and represents our professional advice on correct automobile lubrication.

NAMES OF AUTOMOBILES AND MOTOR TRUCKS	1921		1920		1919		1918		1917	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Allen	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Anderson	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Apperson (8 cyl.)	A	A	A	A	A	A	A	A	A	A
" All Other Models							A	A	Arc	Arc
Beck (Model A, Junior)	A	Arc								
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Biddle	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Buick	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Cadillac	A	A	A	A	A	A	A	A	A	A
Chalmers	A	A	A	A	A	A	A	A	A	A
Chandler Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Chevrolet (4 cyl.)					A	A	A	A	A	A
" Model 490	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" All Other Models	A	Arc	A	Arc			A	Arc		
Cleveland	A	Arc	A	Arc						
Cole	A	A	A	A	A	A	A	A	A	A
Columbia (Detroit)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Comet	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	Arc
" (Commercial)					A	Arc				
Cunningham	A	A	A	A	A	A	A	A	A	A
D-E (¼ ton)							A	Arc	A	Arc
" (1½ ton)	A	A	A	Arc	A	Arc	A	Arc	A	Arc
" (5 ton)	A	A	A	A	A	A	A	A		
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Diamond T (1½ & 5 ton)	A	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (Models U 2 ton & K 3½ ton	A	A	A	A						
" All Other Models			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Dixie Flyer	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Dodge Brothers	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Dort	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Elgin	A	Arc	A	Arc			A	Arc	A	Arc
Essex	A	Arc	A	Arc	A	Arc				
Federal (Model S-X)							A	A	A	A
" (Special)							Arc	Arc		
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	A	A	Arc	Arc
Ford	E	E	E	E	E	E	E	E	E	E
Franklin	A	A	A	A	A	A	A	A	A	A
Giant (using gasoline)	Arc	Arc	Arc	Arc	Arc	Arc				
" (using kerosene			A	A	A	A				
Grant (6 cyl.)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (Com'l.) (Model 12)					A	Arc				
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc				
Hal-Fay	A	A	A	A	A	A				
H. C. S.	A	A	A	A						
Haynes (6 cyl.)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (12 cyl.)	A	A	A	A	A	A	A	A	A	A
Holmes	A	A	B	A						
Hudson Super Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Hupmobile	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
I. H. C.							A	A	A	A
Jordan	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Jumbo	A	A	A	A	A	A	A	A		
Kelly-Springfield	A	A	A	A	A	A	A	A	A	A
Kenworthy (4 cyl.)	A	A	A	A						
" (6 cyl.)	Arc	Arc	Arc	Arc						
King (8 cyl.)	A	A	A	A						
Kissel Kar (12 cyl.)					A	A	A	A	A	A
" All Other Models	A	Arc	A	Arc	A	Arc	A	A	A	Arc
LaFayette (Indianapolis)	A	A	A	A						
Lexington (Continental Eng.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Liberty	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Lincoln	A	A	A	A						
Locomobile	A	E	E	A	E	A	E	E	E	E
Lovejoy (2½ ton)	A	Arc	A	Arc						
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Macmon	A	A	A	A	A	A	A	A	A	A
Maxwell	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Mercer	A	A	A	A	A	A	A	A	A	A
Mitchell	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Moreine (Model M-3)							A	Arc	A	Arc
" All Other Models	A	A	A	A	A	A	A	A	A	A
Nash	Arc	Arc	Arc	Arc	Arc	Arc	A	A		
" (Model 671)							A	A		
" (Commercial) (Quad)	A	A	A	A	A	A	A	A		
" (1 ton and 2 ton)	A	Arc	A	Arc	A	Arc	A	Arc		
National (6 cyl.)	A	A	A	A	Arc	Arc	Arc	Arc	Arc	Arc
" (12 cyl.)					A	A	A	A	A	A
Oakland	A	A	A	A	A	A	A	A	Arc	Arc
Oldsmobile (4 cyl.)	A	Arc	A	Arc	A	Arc				
" (6 cyl.)	A	A	A	A	A	A	A	Arc	Arc	
" (8 cyl.)	A	A	A	A	A	A	A	A	A	Arc
Overland	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Packard	A	A	A	A	A	A	A	A	A	A
Paige (6 cyl.)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (Continental Eng.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" All Other Models	A	A	A	A						
Pan (Model 250)							Arc	Arc		
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc		
Peerless (8 cyl.)	A	A	A	A	A	A	A	A	A	A
" All Other Models							Arc	Arc	Arc	Arc
Pierce-Arrow	A	A	A	A	A	A	A	A	A	A
" (Com'l.) (3 ton)	A	A	A	A	A	Arc	Arc	Arc	Arc	Arc
" " All Other Models	A	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Premier	A	A	A	A	A	A	A	A	A	A
Reo	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Republic (1 and 1½ ton)	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	Arc
" All Other Models	Arc	Arc	Arc	Arc	A	Arc	A	Arc	A	Arc
R & V Knight	B	A	B	A						
Saxon	A	Arc	A	Arc	E	E	E	E	E	E
Scripps-Booth (8 cyl.)							Arc	Arc	A	Arc
" All Other Models	A	A	A	A	A	A	A	A	A	A
Selden (¾ ton)									A	Arc
" (1 ton)	A	A	A	A	Arc	Arc	Arc	Arc		
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Stearns-Knight	B	A	B	A	B	A	B	A	B	A
Stephens	A	A	A	A	A	A	A	Arc	Arc	Arc
Studebaker	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Stutz	A	A	A	A	A	A	A	A	A	A
Templar	A	A	A	A	A	A	A	A		
Velie (Model 34)	A	Arc	A	Arc						
" (Commercial) (¾ ton)					A	Arc	A	Arc		
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Westcott	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
White (16 valve)					A	A	A	A	A	A
" (2 and 3 ton)	A	A	A	A	A	A				
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Willys-Knight	B	A	B	A	B	A	B	A	A	A
Willys Six					Arc	Arc	Arc	Arc	Arc	Arc
Winton	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc

Prominent Makes of Engines

Beaver (Models J-JA-JB and JC)	A	A	A	A	A	A	A	A		
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Buda (Models ATU-BTU-CTU-DTU-ETU-FTU-60U-HTU-IU-ITU-XU-XTU-YU-YTU	A	A	A	A	A	A	A	A	A	A
Buda All Other Models	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Continental (Model B2)	A	A	A	A	A	A				
" (Model T)					A	Arc	A	Arc	A	Arc
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Falls	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
G. B. & S. (Model AA)	A	A	A	A	A	A				
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Herschell-Spillman										
" (Models JT-A-V and VA)					A	Arc	A	A	A	A
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Hinkley	A	A	A	A	A	A				
Lycoming	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Northway (Model 108)					A	A			Arc	Arc
" All Other Models	A	A	A	A	A	A	A	A	A	A
Rochester (Duesenberg)	A	A	A	A						
Waukesha (Models CU-DU-EU & FU)	A	A	A	A	A	A				
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Weidely	A	A	A	A	A	A	A	A	A	A
Wisconsin (Models Q & QC)					A	Arc	A	Arc	A	Arc
" All Other Models	A	A	A	A	A	A	A	A	A	A